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ORIGINAL ARTICLES

THE CRISIS IN ORTHODONTIA*†

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WE ARE now in the midst of a crisis in orthodontia. Old and often-tried methods are being refuted and discarded, and new ones are being brought forth and put in their place, which although highly recommended have frequently not been sufficiently tested by practice.

The entire orthodontic profession is actually divided into four large parties: those who work with very strong forces to reach their goal as quickly as possible; those who sacrifice teeth to achieve their purpose, either with or without system; those who follow the old Angle method by using either the arch wire and ligatures or the modern Angle appliances (ribbon- and edgewise-arch); and finally those who follow Mershon's principles. Furthermore, the pupils of all these various systems talk persistently of their success, without any consideration of their moral obligation to verify their results, particularly as to their permanency, by proper publication of cases.

At this time of crisis, when the beginner is at a total loss as to which way to go in order to succeed, I consider it my duty to discuss some of the basic problems of our profession, even though I may not be able to cover the entire field of orthodontia.

I do not intend to belittle other methods, nor to consider my own viewpoint as the only correct one; however, using the substantial foundation and clinical proofs of many decades of orthodontic practice, I shall attempt to show a practical way out of the present complicated orthodontic situation.

My material shall not be extraordinarily large, for I shall cite only those cases the successes or failures of which I consider absolutely permanent. I wish to emphasize here *that good results immediately following treatment and retention cannot be counted as successful cases.*

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†Translated from *Zeitschrift für Stomatologie*, Nos. 7 and 8, 1933, published by Urban and Schwarzenberg, Vienna and Berlin, from whom the electrotypes were obtained.

Every practitioner, like me, is faced with the difficulty of checking up on "successful cases" of many years ago. Many patients have died or have moved away; others cannot be located because of their lack of interest and for other reasons. Many have not come back to the office because of a failure or relapse, so that it is impossible to give the exact percentage of cases that have been successful. Why should orthodontia differ from the other branches of the healing art, wherein usually only the other man sees our failures, while we are content in the opinion that we are always successful?

Sometimes our failures are due to incorrect diagnosis, sometimes to wrong treatment, and sometimes to both. For some failures we are not at all responsible, because, aside from the fact that patients frequently do not cooperate, we are confronted with some unsolved problems. Sometimes several quite similar cases will be treated successfully, and suddenly one case of the same type will resist all efforts. We must always consider such a possibility; we should be tentative with our prognosis and wait until we have found out whether or not the teeth will respond to treatment at all before making any definite statement; in doing so we shall avoid embarrassing situations.

I shall by no means contend that good results can be obtained only with the Angle method, enlarged and modified by Oppenheim and Grünberg,[1] but I shall again demand that convincing evidence of success be brought forward by the followers of the various other methods.

This paper consists of two parts which will cover the following subjects:

Part I:

1. Tissue changes during active mechanical tooth movement. Directions for the practice.
2. Tissue changes during the period of retention. Skogsborg's septotomy.
3. Critical review of the work of Gottlieb and Orban, A. M. Schwarz, and J. A. Marshall.

Part II:

1. The extraction therapy of Class II malocclusions (Angle).
2. The treatment of Class II malocclusions (Angle).
3. The problem of root resorption.
4. Contributions to the construction of appliances.
5. Permanency of results.*

Part I

1. Tissue changes during active mechanical tooth movement†

My first experimental studies[2] on the teeth of monkeys, and the conclusions drawn from these experiments, have, for many years, been the guiding principle for orthodontic practice. They constituted a turning point from the use of strong forces toward the application of gentle forces. These same experi-

*It is intended to publish all these individual problems together with some additional material in the form of a monograph.

†Translated by Dr. Egon Neustadt.

ments have caused Mershon to undertake his campaign for a slow and prolonged, but at the same time gentle and moderate treatment.*

Recently, Schwarz,[3] on the basis of the histologic findings in his experiments on dogs and upon the findings of Sandstedt[4] and of Gottlieb and Orban,[5] called the results of my investigations erroneous and denied their value. The results of Schwarz's experiments, however, and those of Sandstedt and Gottlieb and Orban, are being propounded as furnishing the guiding principles for modern orthodontic treatment. For this reason, I shall endeavor to demonstrate why this viewpoint is incorrect, and to discuss whether the experimental data of these latter authors can be utilized as a basis for principles of orthodontic practice.

Fig. 1.—Control tooth (deciduous tooth); magnification 8 times. Surface of the cementum intact; *no sign of starting shedding;* apex of the root injured during preparation. *K,* compact alveolar bone; *p,* periodontal space; *c,* cementum.

Before discussing the reports of some new findings, which only verify the conclusion drawn from my first histologic pictures, I wish to make the following statement: In the introduction to my first work, "Tissue Changes Particularly of the Bone Incident to Tooth Movement,"[2] I mentioned that "my findings were not identical either with the elasticity theory of Kingsley-Walkhoff, or with the pressure theory of Flouren, which postulate resorption on the side of pressure, and apposition on the side relieved from pressure."

*Stallard: INTERNAT. J. ORTHOD. ORAL SURG. & RADIOG. 14: 874, 1928. "In his second conclusion, Oppenheim claims that relapsing movements may result from a too rapid movement and that the retention period may be shortened if the teeth are moved gently enough. It was upon this conjecture and the ideas associated with it that Mershon based his contentions for long, gentle treatment."

Some very interesting findings (Fig. 2), for which I found an analogy in conditions present in monkeys at the time of tooth eruption (Fig. 5), induced me to the belief that this analogy in the findings was a proof for the fact that the forces used in my own experiments were of the proper intensity.[2] I accepted the transformation theory of Wolff, because of the transformation which again occurred during the period of retention.

In my above mentioned article, I stated that the process observed constitutes a classic example of the change from compact bone into trabecular bone, and I have defined it in the following way: "The bone tissue, compact as well as trabecular bone, reacts upon pressure with the transformation of its whole architecture. *This takes place through resorption of the present bone and apposition*

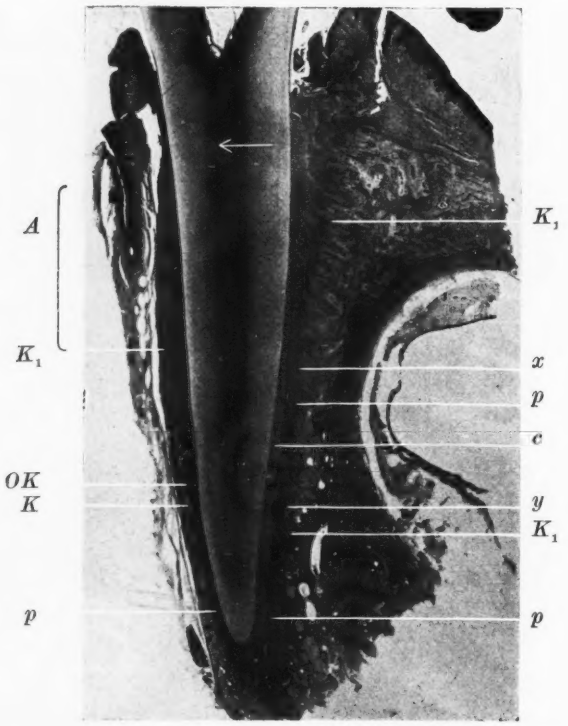


Fig. 2.—Labial movement, direction of force indicated by arrow; general view; magnification 8 times. Duration of experiment forty days; seven adjustments of force in five-day intervals; picture of the active bone reaction to the force, which was applied for the last time five days before death. *No signs of shedding.* On the labial side, the side of pressure (on the left), the newly formed bone trabeculae (K_1), arranged in the characteristic manner in the direction of pressure (arrow); at the same time the old bone K is resorbed by numerous osteoclasts (OK); in the lower third of the root, undisturbed lamellar bone (K); in the region of the apex no evidence of a pressure area; p, periodontal space; c, cementum. On the lingual side, the side of pull (on the right), the formation of osteoid bone K_1, following the stretched periodontal fibers can be discerned until near the apex; there is no evidence of a pressure area at the apex. On some points (x, y) an exaggerated formation of osteoid, narrowing the periodontal space (p); position of the apex unchanged.

of new bone. Both processes start simultaneously." In this original statement, which was made more than twenty years ago, nothing needs to be changed, and also the histologic findings remain in force.

On the basis of new experiments and contributions of other authors during the last years, I can confirm the fact that resorption and apposition are the only two factors which produce changes in the bone tissue; this statement is also borne out by the laws of general bone pathology. In this view I was strengthened

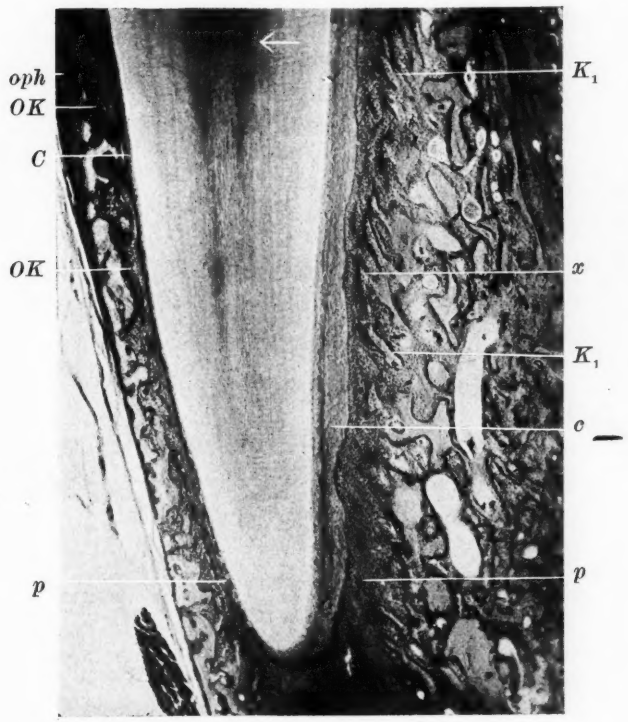


Fig. 3.—Higher magnification (20 times) of the apical area of Fig. 2; movement in the direction of arrow; at *x* under the influence of tension an exaggerated formation of osteoid (K_1) on the side of pressure (on the left) resorption of old bone by numerous osteoclasts (*OK*); at the same time formation of new bone trabeculae (osteophytes) *oph*; *p*, periodontal space; *c*, cementum.

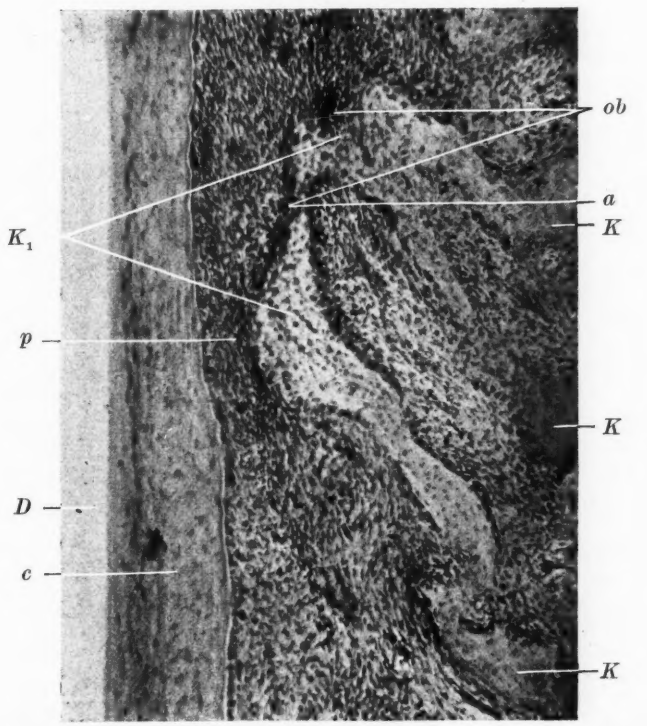
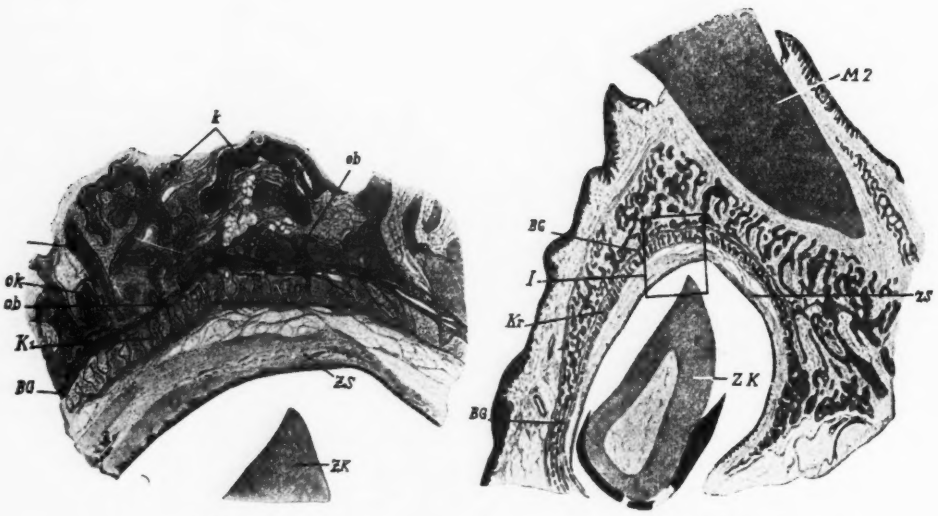


Fig. 4.—High magnification (80 times) of area (*x*) of Fig. 2; narrowing of the periodontal space (*p*); *ob*, numerous osteoblasts; starting union of the osteoid (K_1) of two neighboring bone trabeculae at *a*; *K*, old bone of former alveolar wall; *c*, cementum; *D*, dentin.



(*b*) (*a*)

Fig. 5.—(*a*) The bone trabeculae (*Kr*) above the erupting tooth germ (*ZK*) are arranged in a circle radiating away from the erupting tooth germ in the direction of the pressure; (compare the opposite phenomenon in Figs. 10 and 19); *MZ*, deciduous tooth; *ZS*, tooth sac.

(*b*) Higher magnification of the area *I* of (*a*); the arrangement of the bone trabeculae here is just as characteristic as is the arrangement of the bone trabeculae on the side of pressure during tooth movement (Fig. 6). *ZK*, tooth germ; K_1, functionally arranged bone trabeculae; *K*, old bone; *ob*, osteoblasts; *ZS*, tooth sac.

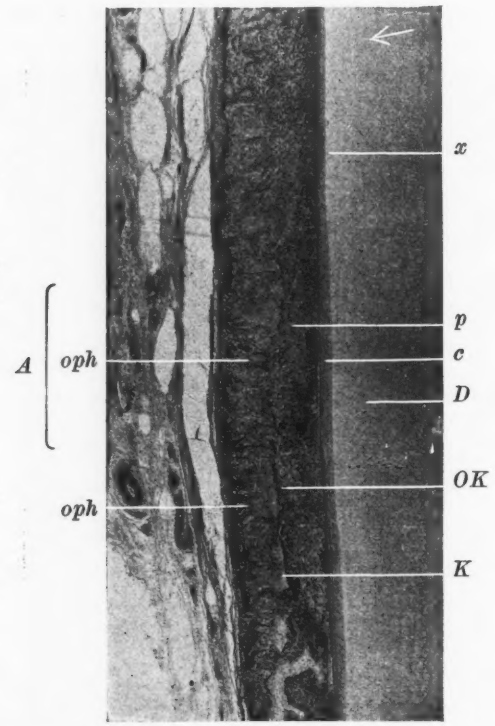


Fig. 6.—Higher magnification (40 times) of area *A* from Fig. 2; the old bone (*K*) is, on the side facing the tooth, resorbed by osteoclasts (*OK*), while on the opposite side of the same bone (*K*), away from the tooth, there are developing in the direction of the force new bone trabeculae (osteophytes) *oph*; at *x* a very shallow resorption of the cementum (*c*); *p*, periodontal space; *c*, cementum; *d*, dentin; direction of movement indicated by arrow.

by the fact that the regressive changes occurring during retention, and ending with the appearance of new lamellar bone, are taking place along the same lines; therefore, I came to the conclusion that either previously formed bone is being transformed, or newly formed bone is being adjusted to the functional demands. The functional adaptation of the bone tissue is, during *active* treatment, induced by *external* stimulations. *The histologic pictures disclose that the new arrangement of the bone trabeculae and of the periodontal fibers represents the best functional adaptation to these stimulations.*

"The terms 'stable' and 'normal' should not be applied to the form of the tissues themselves, but to the potential qualities of the tissues to assume, according to certain stimulations, different forms."[3]

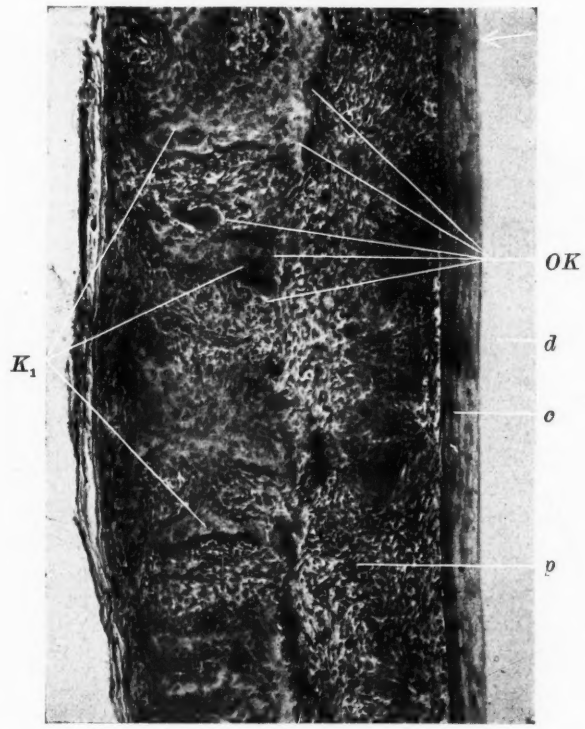


Fig. 7.—High magnification (80 times) of area *A* of Fig. 6; under renewed application of force, the osteoid (K_1) is being resorbed by numerous osteoclasts (*OK*); cementum (*c*) remains intact; *p*, periodontal space; *c*, cementum; *d*, dentin; direction of movement indicated by arrow.

The transformation of the bone could also in my experiment, as I have already stressed, *only* occur through resorption and apposition; without Flouren's pressure theory, there can be no bone change, no bone transformation.

Gottlieb and Orban had to confirm my morphologic findings, namely resorption of bone on the side of pressure and simultaneous formation of new trabeculae, as a safeguard of nature against too great a thinning of the alveolar wall. At the same time, there is a deposition of the new bone on the side of tension, which takes place alongside the stretched fiber bundles of the periodontal membrane. As one compares Figs. 6 and 7, which represent the side of pressure from my monkey experiments, with Figs. 8 and 9, which represent the findings in dog and man of Gottlieb and Orban, one is astonished with the similarity

of the pictures. The same holds true for the tension side of my illustrations, after a five-day application of force (Fig. 11, left), in comparison with the corresponding pictures of the tension side from the Gottlieb and Orban experiments.

In *lingual movement* (Figs. 12 and 13) we find on the lingual side (pressure) the bone trabeculae which have been formed in the direction of the force (functional demand) covered with a wide osteoid lining. Osteoclasts, the representatives of acute transformation, are rare in this location but still frequent on the labial side of the root end, which in this instance has moved in the opposite direction of the crown (Fig. 14). There the application of force had not yet ceased. At the alveolar margin *apposition exceeds resorption.* Under the influence of the rubber wedge the crown of the tooth had soon moved lingually,

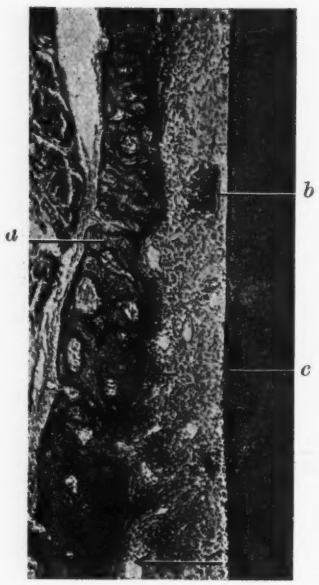


Fig. 8.

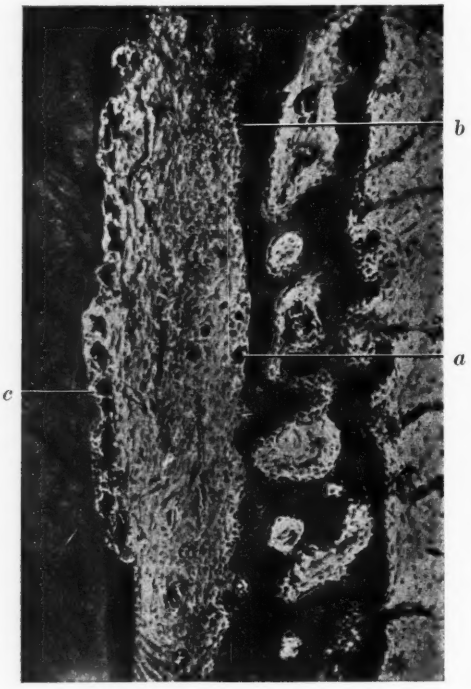


Fig. 9.

Fig. 8.—Gottlieb and Orban's Fig. 60 (dog's tooth). Through the action of pressure (arrow) the old bone was entirely resorbed and was replaced by osteophytes (*a*) which are arranged in the direction of the force (similar to the osteophytes in Fig. 6); cementum (*c*) intact.

Fig. 9.—Gottlieb and Orban's Fig. 194 (human tooth). The old bone was entirely resorbed and replaced by osteophytes which are arranged in the characteristic way. They represent the new alveolar wall. The tooth shows signs of acute resorption (osteoclasts, *c*); bone surface nearly intact.

and in order not to overdue the movement, a rest of more than five days was employed. This extended interval of time between the dates of application of force produced the prompt reaction of the bone, namely the preponderance of apposition. *Despite the heavy deposition of osteoid tissue, the cementum had not been injured at the renewed application of force.* We find a perfectly sound cementum surface (Figs. 12 and 13).

Because of the absence of osteoclasts, Schwarz has regarded this picture (as well as all my histologic pictures) as demonstrating states of rest, and not of

active tooth movement. This view is incorrect,* and shall be discussed in the section "Critical Review of the Work of Gottlieb-Orban, Schwarz, and Marshall." *On the contrary, the absence of numerous osteoclasts as well as the formation of osteoid linings is very characteristic for intermittent tooth movement.*

In Fig. 14 (a higher magnification of the apical region of Fig. 12), we notice the deviation of the root end. On the left side (labially), the side of pressure, there are numerous osteeclasts with a thinning of the periodontal space; on the right side (lingually), the side of tension, there is a widening of the periodontal space.

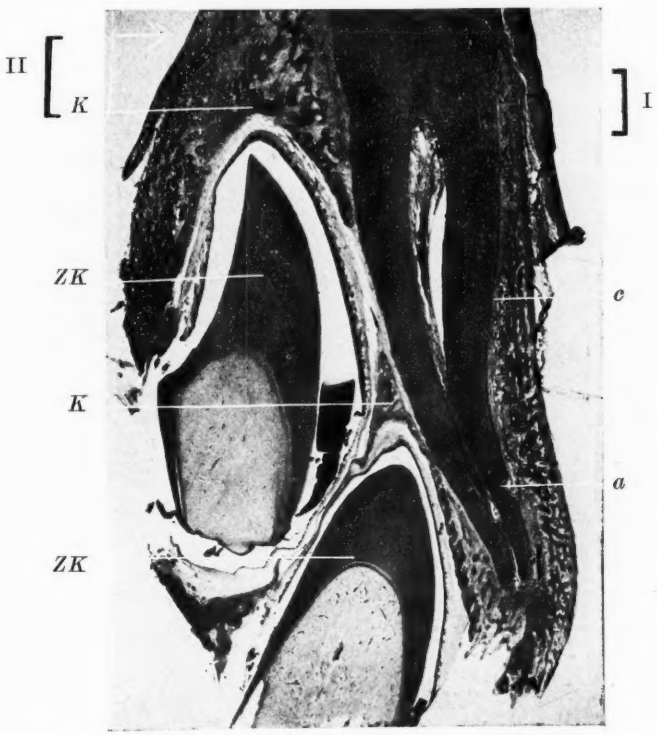


Fig. 10.—Five days' duration of force; magnification 8 times; the direction of movement is indicated by arrow; on the labial side of pressure (on the right) the surface of the cementum (*c*) is intact; at *a* mechanical injury of the specimen; on the lingual side of pull many shallow cementum resorptions, at one place penetrating into the dentin; the bone (*K*) above the germs (*ZK*) is in a state of rest; *no acute sign of tooth eruption.* The region around the apex is unchanged.

In the description of my illustrations, I am showing the deciduous teeth which partook in the tooth movement first in *general views,* in order to refute the objection of Gottlieb[5] and Marshall[8] that experiments on deciduous teeth cannot be considered as conclusive.

I have already stressed the fact, and I do it here again, that the tissue changes around the deciduous teeth, which are due to the tooth movement, have nothing to do with those changes that are due to the shedding of the deciduous

*An unbiased and accurate presentation of my findings can be found in a recent publication of Kronfeld, (Review of Orthodontia, Vol. I; page 11): "By means of these specimens, Oppenheim demonstrates that the only way in which the teeth can change their position in the jaw is by means of resorption and new formation of the surrounding bone." A more detailed and likewise correct description can also be found in Kronfeld's recently published textbook,[6] and in McCoy's textbook.[7]

teeth. True, in some parts of the root surface small areas of resorption are found (never extending into the dentin), but these low grade resorptions have no relation whatever to the characteristic transformation of the bone which I have described. This transformation can only be regarded as a *consequence of an external application of force,* because such pictures are never seen in the normal resorption of deciduous roots. Schwarz comes to the defense of my viewpoint:[9]

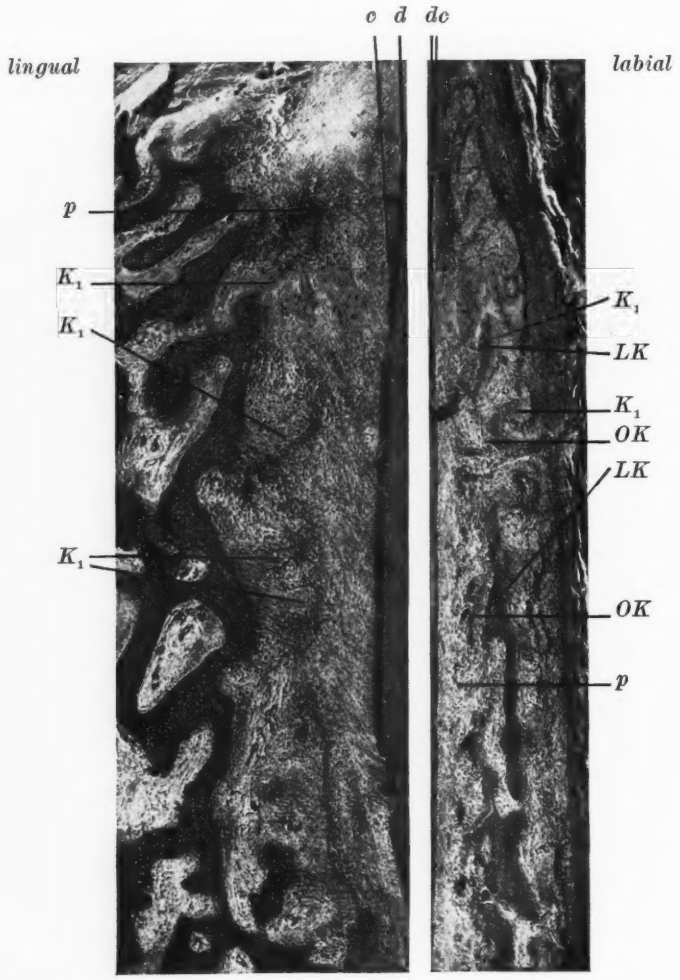


Fig. 11.—Higher magnification (40 times, reduced one-third) of areas *I* and *II* from Fig. 10; labial side (on the right) *LK*, compact lamellar bone; K_1, newly formed bone trabeculae (osteophytes); *OK*, osteoclasts; *p*, periodontal space; lingual side (on the left); K_1, osteoid, formed in the direction of the tension; *p*, periodontal space; *c*, cementum; *d*, dentin.

"Against the conclusiveness of Oppenheim's experiments the argument has been advanced that these experiments were made on the deciduous dentition. This objection is for the above mentioned reasons unwarranted. The forces which Oppenheim has used have been within the second degree of biologic intensity, which is ideal from an orthodontic standpoint. Furthermore, the tooth movement was produced on completely developed teeth, which had well-formed periodontal suspending fibers in the apical region. *For these two reasons, they can be considered of fundamental value for the practice of orthodontia.*"

Let us, for instance, study the general view of the moved deciduous teeth (Figs. 2 and 12, showing conditions after forty-day treatment; Fig. 19 after thirty-day treatment; and Fig. 10 after five-day treatment); and then compare with it the general view of the control tooth (Fig. 1), and also the general views of the four illustrations of the retention period (these illustrations will be found in the section, "Tissue Changes During Retention"). On all these deciduous teeth, we find (with the exception of one retention picture) a nearly perfect cementum covering, all the way up to the apices of the teeth* which could not be found to be more perfect on any permanent tooth. And those teeth which have been elongated, shortened and rotated, show, together with their corresponding control teeth, the same picture of an intact cementum, *without*

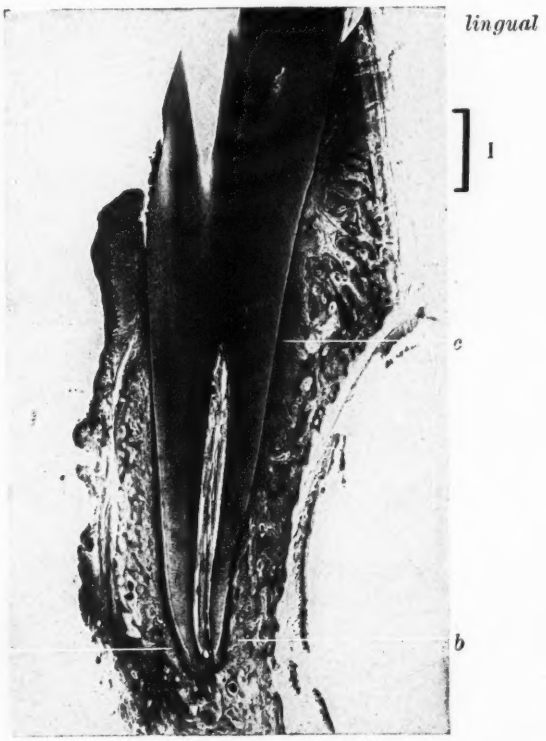


Fig. 12.—Lingual movement; direction of force toward the right side; general view; magnification 8 times; *no signs of shedding;* surface of cementum (*c*) intact; dislocation of the apex in a direction opposite to the movement of the crown; at *a* area of pressure, at *b* area of tension; the periodontal space is narrowed at *a*, enlarged at *b*.

any indication of a beginning shedding of these teeth (the reproduction of these photomicrographs is intended in the monograph). It is impossible to understand how any one, in face of such convincing arguments, can refute the findings on the moved deciduous teeth, just because they were deciduous teeth.

In this respect, Schwarz also supports my viewpoint.[9]

He says: "The reason why in Oppenheim's experiments, despite the use of the same gentle forces, bone resorption took place only cervically, while in the experiments of American investigators (Johnson) resorption took place *cervically* as well as *apically,* is found in the different physical properties of completely

*In Fig. 1 the cementum covering of the apex has been injured during preparation of the specimen.

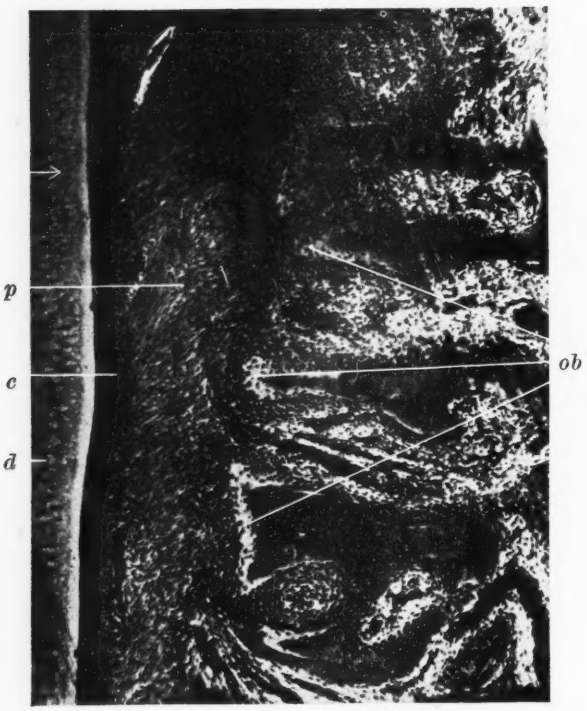


Fig. 13.—Lingual movement; direction of force indicated by arrow; higher magnification (40 times) of area *I* from Fig. 12; the trabeculae are arranged in the direction of force; on the side facing the tooth, they are lined with wide osteoid borders (*ob*); apposition exceeds resorption as intervals between adjustments become longer; in this field there are no osteoclasts. Cementum (*c*) intact; *p*, periodontal space; the periodontal fibers run in their normal direction from the bone downward to the tooth; *d*, dentin.

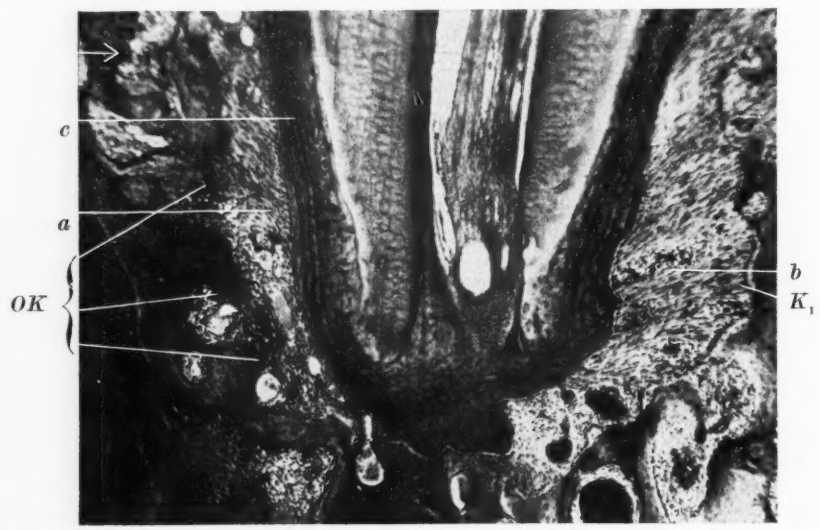


Fig. 14.—Higher magnification (50 times) of the apical region from Fig. 12; the direction of force applied to the tooth crown is indicated by the arrow; the apex of the tooth moved in the opposite direction; the periodontal space is narrowed at *a* (side of pressure), numerous osteoclasts (*OK*); at *b* (side of tension), the periodontal space is enlarged, the periodontal fibers are stretched; formation of osteoid (K_1); *c*, cementum intact.

and incompletely formed teeth. The deciduous teeth which Oppenheim used were completely formed, and therefore they possessed strong apical suspending fibers. This factor restricts the tipping movement of the apex in such a way that with proper application of forces no bone resorption takes place at the apex.''

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(To be continued)

THE RÔLE OF PLASTIC SURGERY IN RELATION TO ORTHODONTIA*

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WHEN some abnormality occurs about the face which in any way involves the musculature or bony structures of the oral cavity, the case becomes one in which both orthodontist and plastic surgeon may be interested. These cases may be of congenital origin or acquired through some trauma. The diagnosis is all important, for upon it depends the proper course of treatment, and often what sort of prognosis may be given.

Fig. 1.

Congenital abnormalities require a thorough understanding of the normal development and the factors which enter to cause the deformity. If, for example, there exists an entire absence of one ramus, and an open mouth cavity extending to the second molar, it is a foregone conclusion that the teeth when eruption occurs, will drift to the open side, because of the lack of support from the surrounding musculature and the lack of control of condyle paths through the medium of the glenoid fossa which is absent. An orthodontic attempt at correction without surgical interference would result in disappointment or failure. (Figs. 1 and 2.) A similar error may occur in orthodontic treatment where there is an asymmetry of the face. (Figs. 3 and 4.)

*Delivered before the Orthodontic Section at the meeting of the California State Dental Association, Oakland, Calif., April 4, 1932.

Other congenital deformities require keen understanding and cooperation between both surgeon and orthodontist if a normal dental arch is to be attained. Clefts of the palate and lip are deformities which are difficult to correct and unfortunately result in a high percentage of failures. The term failure is used here in its relative sense, for the reason that there is such a wide variance of opinion as to what constitutes a perfect result. The soft tissues of the palate

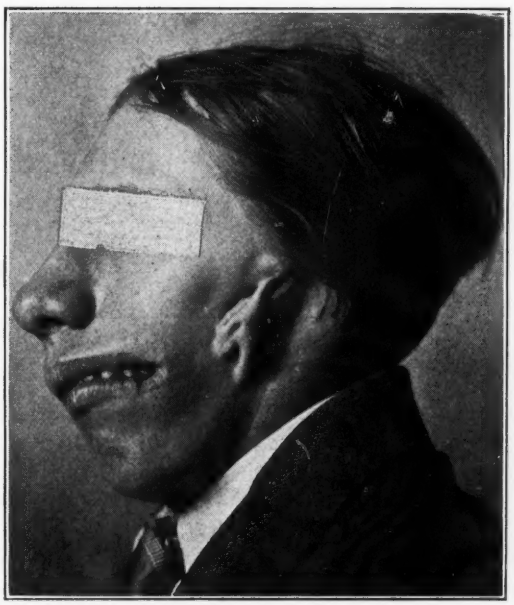

Fig. 2.

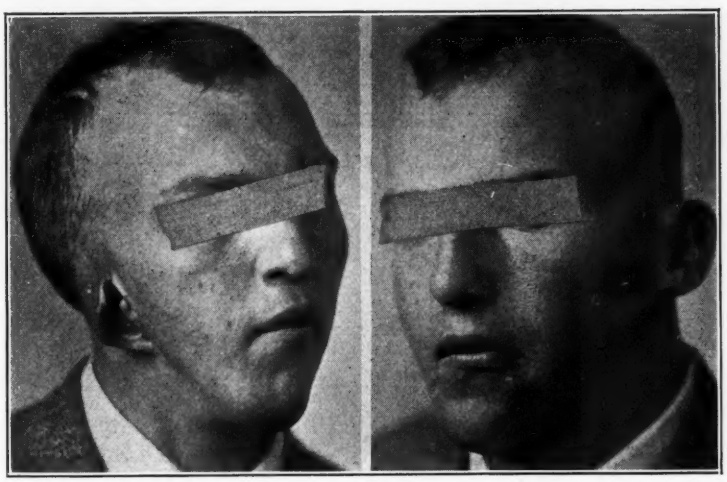

Fig. 3. Fig. 4.

may be closed, but there may still exist a cleft of the bones which increases when orthodontic measures are instituted. In the majority of clefts where there is involvement of the alveolar ridge, orthodontic treatment is necessary whether the patient is operated upon or not. Unfortunately the orthodontist rarely sees these cases until the child is from four to ten years old. The surgical correction has been made, and the problem of orthodontic treatment is before him. If bony

union has been obtained by the surgeon, the teeth may be moved to whatever position is required for normal occlusion without deformity. If, however, the bones have been merely approximated, when the arch is expanded there results a corresponding widening of the cleft, and the deformity is increased, even though the teeth may be brought into occlusion. This condition may be the result of surgical failure at the primary operation where bony union was attempted but not obtained, or may be the result of approximation of the bones without attempting bony union.

As is well known, the Brophy followers insist that bone surgery is essential in the treatment of cleft palate. Those who oppose Brophy's operation believe that the traction of the orbicularis oris, produced by uniting the cleft lip first, is sufficient to approximate the bones, and obtain a result without endangering the tooth buds. It is a very much mooted question at the present time among various operators.

Fig. 5. Fig. 6.

The discussion which arises between the two factions centers upon the problem of wiring the cleft bony elements, until firm union has occurred. The Brophy school teaches that a firmly united dental arch is the foundation for all succeeding operations—that upon the formation of a normal dental arch depends the formation of a normal lip and nose. Many failures have occurred—many tooth buds have been displaced—mistakes have been made, but when one considers the large number of surgeons attempting these operations, is there sufficient evidence to condemn it without a thorough understanding of what constitutes a normal dental arch?

Even though a few tooth buds were displaced or lost in obtaining a bone union, it would appear that a firmly united arch would be better than an approximation without loss or displacement, for upon this foundation must depend the orthodontic treatment.

A surgical tragedy which leaves the orthodontist helpless in ever establishing normality are those cases wherein the premaxillae have been excised. (Figs. 5 and 6.) These bones, containing the four incisor teeth, are an integral

part of the dental arch and must be preserved. Their loss means that the patient is condemned for life to wear some sort of prosthetic appliance to correct the deformity produced. Some surgeons attempt to form a dental arch after excising the premaxillae by forcing the lateral halves of the maxillae together. In these cases the canine teeth occupy the positions normally taken by the central or lateral incisors; the tuberosities are widespread, and there is present a large oronasal sinus which increases in size as orthodontic treatment proceeds. The mandible, gradually attaining size, is in normal position, but is oftentimes erroneously diagnosed as prognathic. (Figs. 7 and 8.)

In 1924 I published a paper in *The Lancet* making a plea for the preservation of the premaxillary bones. A search of the literature revealed several text-

Fig. 7. Fig. 8.

books, both foreign and American, advising the excision of these important structures. Such practices cannot be too strongly condemned.

The orthodontist ofttimes asks the question, "What procedure must I follow and what may I promise the parents of children with deformities such as these?" The procedure must be that logical course which, in his opinion, is best for the patient. If he feels that he can obtain normal occlusion after months of endeavor, at the expense of an increase of the cleft bones (where union has not been made) it seems that dissatisfaction would result. Criticism of the surgery in these cases leads only to misunderstanding, but if a consultation between the orthodontist and the surgeon is obtained, some plan may be worked out whereby a result, satisfactory to all, could be assured.

If by gradual movement the edges of the cleft bones can be brought into contact by the orthodontist, the surgeon can, with a minor operation, freshen the edges of bones and suture flaps over the area of contact. This contact may

then be maintained by orthodontic appliances for a period of six weeks, when the bones should have firmly united. If, however, the cleft is too wide, or the patient has reached an age where such measures are impracticable, a more drastic opera-

Fig. 10.

Fig. 9.

tion is necessary. A flap is raised on the side opposite the cleft—usually in the region of the first premolar. A groove is chiseled in the outer plate of the alveolus and extending high up over the root of the canine and thence at right angles under the nasal floor. A green-stick fracture of the maxilla is made at

this groove, and the edges of the cleft are freshened, brought into contact and held with through-and-through wire sutures until union occurs.

In patients up to the age of fourteen years, this method, as a rule, offers a means of closure of the cleft bones and the formation of a firm dental arch. With this foundation, normal occlusion may be established by the orthodontist. (Figs. 9 and 10.)

Normally the width of the maxilla is much less than that of the mandible, the rough measurement being approximately one-half the thickness of the mandible. Teeth and alveolar process excluded, this condition exists throughout life. In clefts involving the bones, however, the order is reversed; and in those cases where no effort has been made to control the spread of the arch, the mandibular teeth following the maxillary teeth until the distance between the buccal surfaces of the third molars has registered as high as three and three-eighths inches.* The impression prevailing among many practitioners that if normal occlusion occurs, the dental arch must of necessity be normal, is a fallacy. In

Fig. 11.

clefts, even when the anterior part has been united, the arch is almost invariably broader than normal, and if the lingual cusps of the maxillary molars occlude in such a manner as to rest over the buccal cusps of the mandibular molars, the mandibular molars will follow the spreading maxillary arch at the tuberosities under the force of mastication. The farther the tuberosities are separated, the shorter the soft palate will be when closed. While this shortening affects only the end-result of the palate operation—that of proper phonation—the orthodontist may be at a loss as to the method of procedure due to the widespread arch. Were there no other reason for the early bone union than the prevention of this spreading at the tuberosities, the patient should receive this consideration. (Fig. 11.)

Chalmers Lyons in a recent paper on cleft palate states that in all cleft palate children, orthodontists have found it more difficult to treat the jaws of these children because of an apparent lessened activity of the process of osteogenesis.

*Brophy's case, p. 128, *Cleft Lip and Palate.*

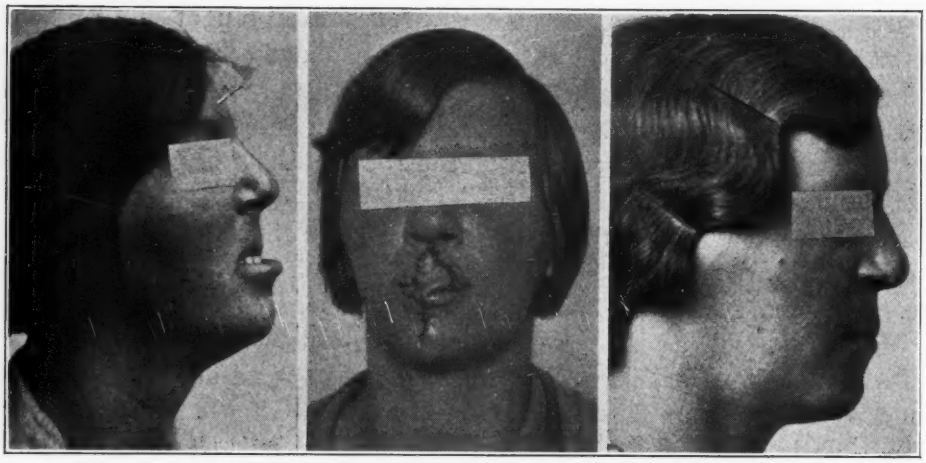

Fig. 12. Fig. 13. Fig. 14.

Fig. 15. Fig. 16.

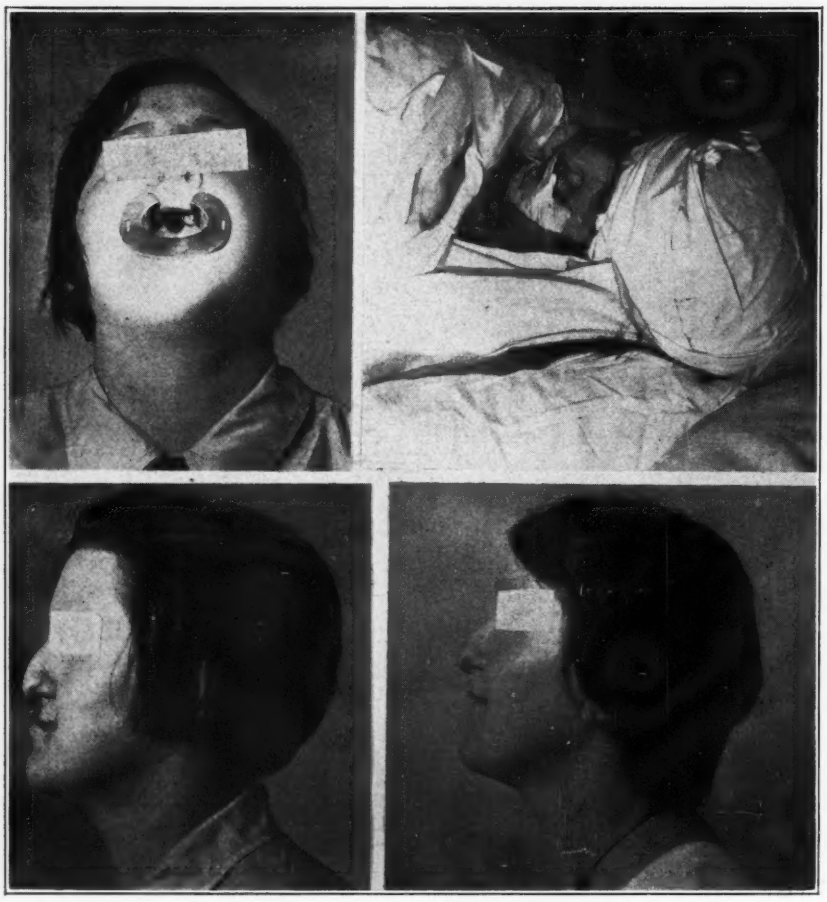

Fig. 17. Fig. 18.

J. S. Foote in December, 1921, published a paper in the *Journal of the American Dental Association* entitled "Cleft Palate as a Local Evidence of a General Faulty Development of the Osseous System."

In my experience I have not found this true clinically.

Some cleft palate cases require all the ingenuity of the surgeon, and an inexhaustible supply of patience on the part of both the patient and the operator to overcome some of the difficulties encountered. Where there have been a number of operations done with partial or complete failure, tissues must be taken from adjoining areas, or even areas far removed from the defect, to restore even a near-normal relationship. (Figs. 12, 13, and 14.)

Fig. 19. Fig. 20.

Fig. 21.

In certain cases where an actual loss of tissue, through slough or necrosis occurs, it is necessary to bring a tubed pedicle from the chest or abdomen to supply the defect, and if the teeth are also lost, to resort to some form of prosthesis to restore the loss and overcome the apparent prognathism. (Figs. 15-18.)

Cases other than clefts, or cases in which clefts exist complicated by other conditions, require careful study to determine not only the proper method of

treatment, but the cause as well. Those cases of micrognathia or brachygnathia, especially, are of interest to the orthodontist. A case in point, complicated by a cleft of the soft palate came under my observation and, without the judgment and supervision of an orthodontist (Dr. Robert Dunn), the treatment would have been much as has been practiced formerly. (Figs. 19 and 20.) The particular interest to the orthodontist is the development of the mandible in this case. The ramus was almost at right angles to the body instead of an obtuse angle as is normal for an infant. The use of the appliance on the ordinary nursing bottle (Fig. 21) over a period of months shows what the development of musculature will accomplish under favorable conditions when bone is only partially calcified. A complete report of this case was published in the *American Journal of Diseases of Children* (vol. 45, p. 799).

Numerous other cases might be cited wherein the interest of the ortho dontist and that of the plastic surgeon are both stimulated, but if the cases herein presented point the way to a closer cooperation between the two professions, this paper has served its mission.

AN ORIGINAL PROCEDURE FOR THE REPLACEMENT OF MISSING TEETH AFTER COMPLETION OF ORTHODONTIC TREATMENT*

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IT IS sometimes necessary to replace missing teeth after orthodontic treatment, a situation occurring in both children and adults. The causes of this condition are so numerous, and have so little to do with the technic of replacement that the question of etiology will not be discussed here. It is with the problem of replacement that we are concerned at the present moment. Particularly do I wish to discuss those cases upon which the orthodontist has spent a great deal of time and effort, and which, upon completion, he has turned over to the general practitioner or to the specialist for the replacing of any teeth. Should this restorative work be attempted by the usual procedure, failure will be inevitable. Drifting of the teeth will ensue invariably, with the subsequent impairment of functional contacts, not to mention esthetics, particularly when the anterior part of the mouth is involved. What a disappointment to all concerned, after months of orthodontic treatment!

It is true that the use of the regulating appliance as a retainer is better than nothing, but it is not stable enough to allow the operator to obtain the best results. It is generally found that the appliance must be removed during the preparation of the abutments, and that, upon insertion, the bands no longer fit the prepared abutment teeth, nor do the spring wires maintain contact with the teeth which we are most anxious to retain in position. For unaccustomed hands it is a precarious procedure indeed to attempt such adjustment on these appliances, nor is it always practicable to have the attending orthodontist do it, because every time the temporary stoppings are removed or replaced, some change will manifest itself in the contour of these fillings, necessitating an entire adjustment. Under these conditions, even the most skilled orthodontist cannot be sure that some slight drifting or movement will not ensue. For these reasons I have sought to determine a more definite means of retaining these teeth in position, and because my efforts have met with most gratifying results, I have written this paper, presenting my technic.

Our choice of the type of bridge is not particularly influenced by a case of this sort. The type of restoration most suitable for the same conditions in the normal mouth will generally be found satisfactory. Of course, our development, experience, and belief in the principles of the spring-lock bridge influence us to favor this type of restoration. In one respect only does a case like this differ from the usual restorative case. We must definitely hold the teeth apart until the restoration is completed. This most important requisite will not be taken care of by the usual bridge technic, particularly when the

*Read before the Eastern Association of Graduates of the Angle School of Orthodontia, November 14, 1932.

case on hand involves all the teeth in the arch, as shown in the accompanying illustrations. The opening of one or more of the interproximal contacts in the maxillary anterior part of the mouth is not unusual (Figs. 1 and 2). Its various courses and treatments lie in the orthodontist's field and therefore will not be discussed here. Suffice it to say that Dr. Neustadt moved these anterior teeth mesially by an orthodontic appliance, which movement opened the interproximal space between the right canine and the first premolar, and increased the distance between the canine and the molar on the left side. This treatment completed, the patient was sent to me for the necessary restorative work.

As the work which disturbs the appliance least should be accomplished first, the premolars were prepared. Novocaine had been injected in the mucous

Fig. 1.—The case as presented before orthodontic treatment. Note the gold inlays in the maxillary right premolars and the bridge which supplied the maxillary left premolars and the first molar. Because of tongue habit, the space between the central incisors was increasing rapidly.

Fig. 2.—The palatal and facial aspect of the models of the maxilla before orthodontic treatment. Note that although the first molar and both of the premolars were missing on the maxillary left side, they had been replaced, owing to the drifting of the teeth, by three premolars.

fold, buccally to these teeth. First the appliance and then the inlays were removed, and next these teeth were prepared for jacket crowns. After the tube impression, shade, plaster impression, and bite had been taken, celluloid crown forms with contour were placed so that they did not interfere with the bite, but snugly closed all contacts between the canine and the first molar. The forms were then filled with the proper shades of silicate cement and guided to their proper positions. When the cement had set, a few wisps of cotton were wound around a piece of wax floss. The floss was passed between the contact of the canine and the temporary crown of the first premolar, the wisp of cotton drawn into the interproximal abrasure, and the floss knotted with slight pressure against the occlusal contact. This assured tight contacts right up to the central incisors. Such a forced contact, as I call it, is essential in a case of this sort; without it, a part at least of the space between the

central incisors is certain to appear after the finished crowns are placed in the mouth. After the finger spring had been slightly bent so that it disengaged the canine, the appliance was returned to its position in the mouth, and the patient was dismissed.

The laboratory procedure for the finishing of these crowns did not vary from the usual procedure, excepting in one detail, the exaggeration of the contacts between the canine and the first premolar, and between the second premolar and the first molar. This point is extremely important, as the space which the ligature creates between the canine and the first premolar, and that which the anchor band creates on the first molar, though slight, must be taken up by the crowns to prevent drifting. This detail is easily effected by scraping the model at these points.

In the treatment of this type of case, it is often found necessary to make one or more unusually long appointments. Whenever the appliance must be disturbed, there can be no stopping until adequate provision has been made to prevent drifting. Particularly is this true when the anchor bands must be disturbed in order that these teeth be prepared for anchors for a bridge.

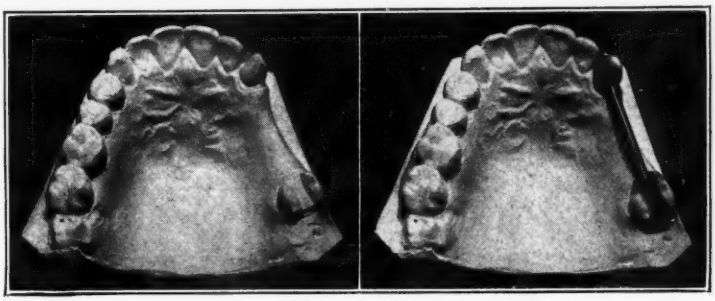

Fig. 3. Fig. 4.

Fig. 3.—The model of the maxilla after orthodontic treatment was completed, the jacket restorations cemented into place, and the preparations for the bridge abutments completed.

Fig. 4.—This shows the manner in which the temporary castings with the 12-gauge wire between them were used to retain these teeth in position. The open end at the molar allowed the building of this contact with solder in order that the anterior contacts would be tightly closed.

For example, let us consider the case under discussion. In order to be sure of all important tight contacts when the finished jacket crowns were placed in the mouth, it was necessary to dispense with the anchor band on the right first molar. Had the case been left in this condition only overnight, distal drifting of the teeth on the opposite side would have ensued. Therefore, when these crowns were set, and the appliance was made useless, the entire case would have been jeopardized had I left it before ample provision had been made to make such drifting impossible. For this reason an afternoon was set aside so that an appointment could be made for one o'clock and continuing until the finish.

At this time the entire appliance, together with the anchor bands, was removed, the temporary crowns were taken off, and the finished jackets fitted in place. As the contacts of these crowns with the canine and molar had been purposely exaggerated, they were carefully dressed down until they were seated snugly in position, after which they were checked for fit and occlusion,

and sent to the laboratory to be glazed. The glazing was easily accomplished, as the platinum matrix had been left intact, and the technician had the furnace hot and ready.

With this laboratory procedure in progress, I started to prepare the abutments for the bridge. As these teeth had been anesthetized previously, no time was lost. The old castings were removed and the preparations reshaped (Fig. 3). Next, inlay wax was squeezed into these inlay preparations, cleared so that they did not interfere with the occlusion, withdrawn, and sent to the laboratory to be invested and cast in scrap gold. It was necessary to see that these matrices had definite seats, as they were to be for temporary castings, but the margins and occlusion were not fussed with. By the time the jackets, now finished, were cemented into position, and the compound impressions of the abutments (two pieces for the canine) and wax bite had been taken, these temporary castings were finished. They were placed in position in the mouth, and, although margins were not fussed with, I was careful to see that the castings had definite seats, and that they did not interfere with the occlusion. At the same time I made sure that the mesial contact of the canine was established. Next, a plaster impression was taken of this area and the castings; the exposed surfaces of these castings were coated with vaseline; and a model was immediately poured of fusible metal, a procedure not only giving a good model, but also making immediate separation possible. A recess was then cut into the molar and a piece of 12-gauge round wire was fitted between this recess and the three-quarter crowns on the canine, gingival to the occlusal plane. (Much future trouble can be avoided if care is exercised at this time in the proper placing of this wire. It is better not to have occlusal contact and wiser if the wire is placed far enough gingivally so that no interference will ensue.) This wire was then plastered to the canine by means of sticky wax, removed, invested, and soldered.

The value of a retainer for this purpose lies in the open end. When it is tried in the mouth, it will be found that it fits nicely; but if used as it is, a space between the central incisors will be foreseen at the next visit of the patient, and if a bridge be constructed with the abutments in this position, failure to keep good contacts closed will ensue.

If, on the other hand, solder is added to the end of the wire until the retainer goes into place with a slight binding, we are assured that any possibility of drifting over here, or after the bridge is finished, will be eliminated. The space is easily widened now. It cannot be widened after the bridge is finished. We therefore added solder to the end of the wire in this case until this binding manifested itself. The inlays and the abutment teeth were then dried, and the retainer was fastened in place with chlora-percha; whereupon the patient was dismissed.

A week was allowed to elapse before the next appointment, in order that the teeth could become settled in this position. The retainer was then removed, and after the permanent castings were checked for contact and occlusion, and a plaster impression and bite and shade were taken, the retainer was replaced and again fastened with chlora-percha. A week later the finished

bridge was cemented in place, and after the usual check for occlusion, the patient was dismissed as finished (Figs. 5 and 6).

Anterior cases, whether in children or in adults, are handled in like manner, the only exception being that facings instead of wire are used to retain the space and to keep the contacts closed. The case of missing lateral incisors

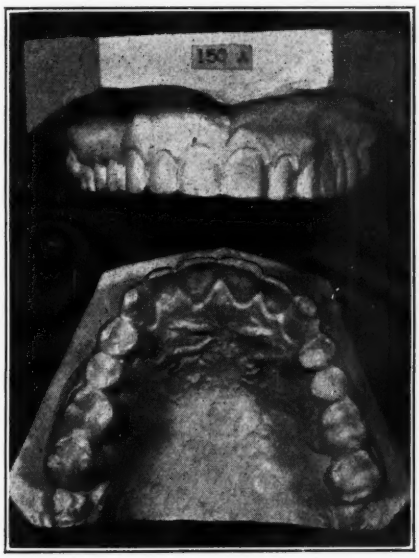

Fig. 5.

Fig. 6.

Fig. 5.—The facial and palatal view of the models after the restorations were completed. It was then possible, on account of the increase in space, to place the two premolars and the first molar on the bridge.

Fig. 6.—The patient one year after the restorations were made.

Fig. 7. Fig. 8. Fig. 9.

Fig. 7.—The model of another case before orthodontic treatment; lateral incisors missing.

Fig. 8.—After orthodontic treatment, with pin ledges prepared for bridge abutments. Although only one side is shown here, both were done at one sitting when the case was made. The left side is purposely left open on the cut so that the reader may see the condition before the preparations were made.

Fig. 9.—One of the temporary bridges in place. The pontic was not soldered to the central incisor; this contact was built up with solder to insure binding. This position definitely maintained the space and the contacts until the permanent bridge was finished.

(Fig. 7) is well known to the orthodontist, and the drifting of these teeth while the bridge is being constructed is nothing new to him. After the regulating has been accomplished (Fig. 8), pin ledges are often used for abutments. Temporary castings are made directly, and a facing instead of wire is used to retain the space (Fig. 9). Although both of these bridges would be

constructed at one time in a practical case, only one is shown here, as it allows the reader to see the condition before and after this retainer is made. Moreover, the facing is joined to only one of the castings. This allows the contact with the other to be built up with solder until a slight binding manifests itself, in accordance with the manner and method outlined in the other case. (Refer to illustrations.)

CONCLUSION

The type of bridgework used is the same as for a usual case presenting the same problem of restoration. Whether a fixed, a semifixed, or one of the removable bridges is selected, is left entirely to the judgment of the operator. Selection is made exactly as though no orthodontic work had been done. The secret of restoring this case successfully, I have found, lies in slightly forcing the contacts of the remaining teeth, and in developing a technic which would retain them definitely in this position for the finished restoration. I have used the outlined technic sufficiently to feel sure that it will give these results.

A TECHNIC FOR MEASURING THE RELATIVE MOVEMENTS OF TEETH DUE TO THE GROWTH OF THE JAWS OR THE PREMATURE LOSS OF DECIDUOUS TEETH*

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A GROUP of 209 children under observation for a period of fifteen years in the Division of Child Research, Department of Preventive Dentistry, New York University, supplied the material for measurement.

This group of individuals, ranging in age from one week to seven years, will have impressions and casts of their mouths made yearly. Only a small percentage will have any orthodontic treatment until after the age of twelve years, so we will have records of untreated individuals for a period of years.

The technic, about to be described, was developed in order that we might show on one graph the change in form and dimensions of the dental arches and at the same time, portray the relative movements of the teeth due to normal or abnormal growth changes of the jaws. Likewise, we can study the relative changes in position of teeth and changes in arch form due to the premature extraction of deciduous teeth, habits, etc.

With a suitable projecting instrument,† the dental pantograph, an orthographic projection of the dental cast is made, the *model having been leveled* on the occlusal plane (Fig. 1). At this point, I must stress the importance of the proper leveling of each subsequent model before surveying, and also to ask that this technic be not compared or confused with other studies of the growth of the head, the object of which is to determine the positional change of the denture in relation to other anatomic points. In this phase of our investigation, we are not concerned with the growth of the head as a whole, nor with the progressive downward and forward movement of the denture in its relation to the calveria. We wish simply to record the relative changes in tooth positions due to any force without regard to its nature or source.

Having completed the horizontal map of the denture we proceed to spot a central point in each tooth (tooth centroid) and then calculate the geometric center of the tooth centroids (denture centroid) through which passes the axis of least asymmetry (Fig. 2).

In normal dentures a smooth curve may be drawn through the tooth centroids of the maxillary and mandibular teeth. These curves are designated as arch form. The importance of accepting this curve as defining arch form, rather than the usual one falling on the buccal cusps and incisal edges, may be upheld from several viewpoints (Figs. 3 and 4).

*Read before the New York Society of Orthodontists, March 14, 1933.

†For description of instrument and map technic see paper "Description of Three Instruments for Use in Orthodontic and Cephalometric Investigations, with Some Remarks on Map Construction," by F. L. Stanton, G. D. Fish, and M. F. Ashley-Montagu. Jour. Dent. Res., Vol. 9, No. 6, pp. 885-902, 1931.

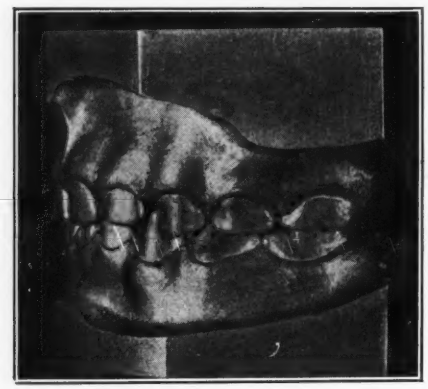


Fig. 1.—Model of normal occlusion (patient aged three years and six months).

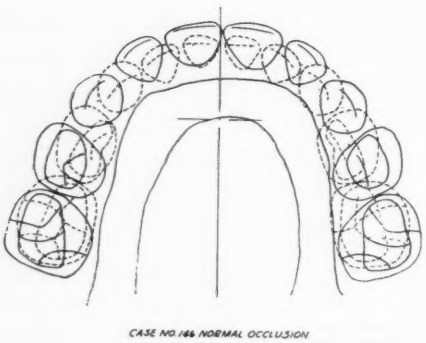


Fig. 2.

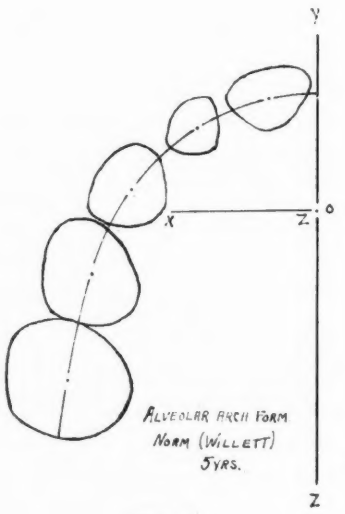
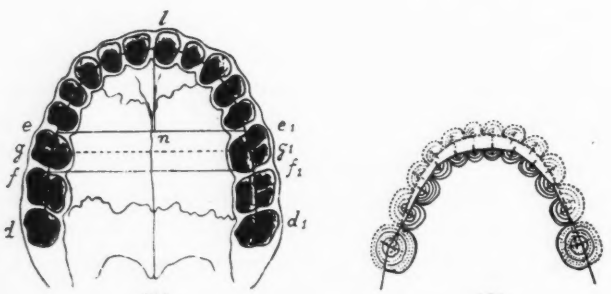


Fig. 3.

Fig. 2.—Horizontal map of case shown in Fig. 1. Maxillary teeth—solid line. Mandibular teeth – dotted line. Dots in centers of tooth areas are the tooth centroids. Axis of least asymetry is shown on which appears the denture centroid.

Fig. 3.—Left side of maxillary arch. (Normal occlusion.) A smooth curve drawn through the tooth centroids.



(1) (2)

Fig. 4.—Franke's illustrations. (1) A smooth curve drawn through the midalveolar points. This curve is similar to curve through the tooth centroids. (2) Franke's placement to show the relationship of the deciduous and permanent dentition. The permanent incisors distal to the deciduous incisors.

1. The curve represents the true alveolar arch form as it lies over the center of the alveolar arch.

2. It is a truer index of arch form because it is not affected by the varied inclinations of incisors in orthognathous and prognathous races.

3. In the study of arch form on skulls the loss of incisor teeth does not affect the investigation.

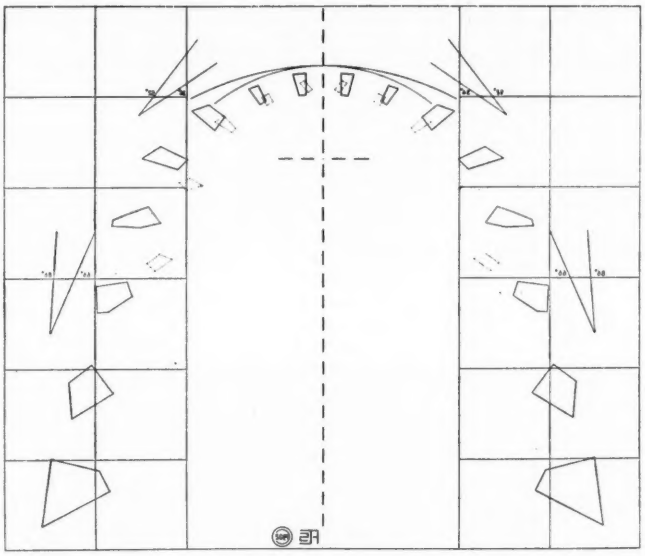


Fig. 5.—Author's placement to show relationship of the deciduous and permanent dentitions. Irregular boxes (solid lines) are the areas of variation of the tooth centroids (nine normal permanent dentitions). The boxes (dotted lines) inclose areas of variation of the tooth centroids (six normal deciduous dentitions). The two anterior arcs represent the variation of curvature of the permanent dentitions. Lines opposite canines and molars show the variation in the positional angulation of the canines and molars in skulls with normal occlusion.

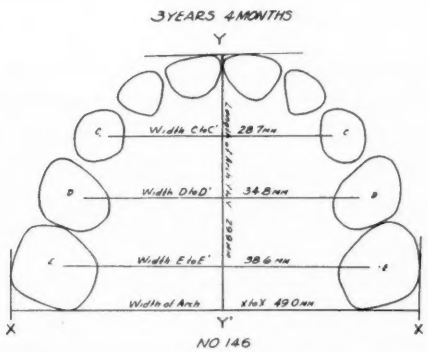


Fig. 6.—Horizontal maxillary map of normal occlusion to illustrate technic of measurements.

Widths are measured between centroids of canines, first and second deciduous molars.
Arch length Y to Y'
Arch width X to X'

$$\text{Arch index} = \frac{WX\ 100}{L}$$

In Franke's study, the teeth of skulls were sectioned at the alveolar level, and a similar curve was drawn by Franke. The curve represents the true alveolar arch form (Fig. 5).

Linear measurements are made on the maps: between centroids of maxillary canines, between centroids of maxillary first deciduous molars, between centroids of maxillary second deciduous molars, between centroids of mandibular canines, between centroids of mandibular deciduous molars, between centroids of mandibular second deciduous molars (Fig. 6).

Length of arch from a line connecting most distal part of second deciduous molars to parallel line touching the most mesial aspect of the arch. Width of arch is greatest width measurement to be made at right angles to axis of asymmetry to the most buccal aspects of the second deciduous molars.

$$\text{Index of arch } \frac{\text{Width} \times 100}{\text{Length}}$$

By means of the linear measurements between the tooth centroids at different ages some interesting data are obtainable, and these points are determinable in all subsequent maps, no matter how much the tooth anatomy may be

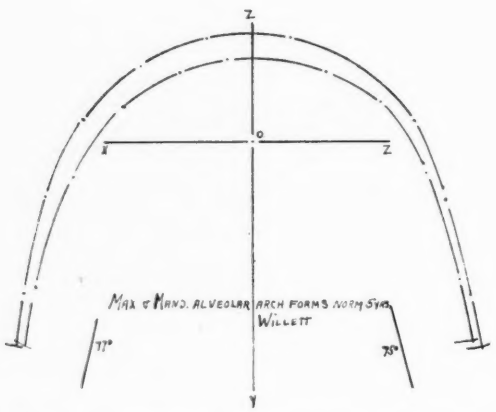


Fig. 7.—The interrelationship of maxillary and mandibular arch forms. (Normal occlusion age five years.)

mutilated by wear or caries. It appears to me that this technic is superior to any previously reported by other investigators interested in measuring changes in the width of the dental arch.

In Fig. 7 there are two interrelated smooth curves with a series of dots representing the tooth centroids. This graph of the maxillary and mandibular arch forms shows that while both curves are smooth, they are dissimilar in form, i.e., the mandibular approaches the maxillary curve at the distal end of the arch. In the permanent dentition they meet in the region distal to the second molar back of which the mandibular curve may lie outside of the maxillary curve. Likewise, in prognathous races the mandibular incisal curve may lie outside of the maxillary.

We find from our linear measurements that the growth is greater between the canines than between the deciduous molars, yet the curves of arch remain smooth in each subsequent map of normal cases; hence, in growth the dental arch form is constantly changing the character of its smooth curvature. As the distance between the canines increases more rapidly than in the distal diameters of the arch, the front arc, from canine to canine, increases its radius

of curvature, i.e., becomes a blunter curve. As we are dealing with two interrelated curvatures of different forms which are both undergoing changes of curvature, it therefore follows that all interrelated points (tooth centroids) on the two curves of the original map *must show a changed interrelationship, in subsequent maps, due to the change in curvature* of the two arches. To put it orthodontically, the mesiodistal occlusal relations of the deciduous molars are changed by the lateral widening of the arches, more in the canine region and less in the molar region. Other investigators noting this occlusal change have attributed it to a more rapid growth forward of the mandible, carrying the mandibular denture forward en masse, thus they account for the mesial drift of the mandibular molars.

If a workable formula for relating two graphs of the same denture at different stages of growth could be found which would accurately portray the relative movements of the teeth due to growth or extrinsic forces, we should have a good measuring rod to evaluate the phenomena which have puzzled several investigators and led to widely different interpretations.

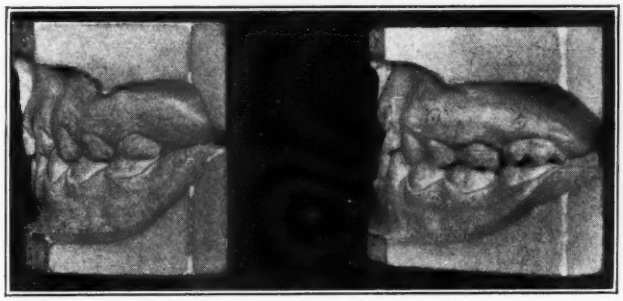


Fig. 8.—Left model age four years and ten months. Right model age six years and one month.

The formula selected for relating maps was based on the following premises:

We desired to compare a configuration (the denture) with slightly changed configuration (the same denture altered by growth forces). We were fortunate in finding our original figure (denture at two years) possessed a high degree of symmetry and that its units (the teeth), being preformed, would not increase in size and would suffer only a slight change due to wear and caries. These units were imbedded in a medium in a state of flux which would alter the form of the denture by rearranging the units in a slightly altered configuration still possessing nearly the same degree of symmetry but of necessity changing the interrelations of the units on the opposite jaws. The comparison being made yearly the maximum change between any two points on opposite sides of the jaws would be less than 2.5 mm.

Gilbert D. Fish, C.E., reasoned that as we wished to compare two stages of the same dentition, slightly altered by forces, the maps should be related so that all points on the first map should be placed nearest the similar points on the second map, so that the sum of the squares of displacement should be a minimum. (Theory of "least squares.") In practice this means the drawing of a composite map, from any series of maps, registered by means of the denture

centroids and axes of symmetry. In order to use this formula it was necessary to represent each tooth as a point, hence, the selection of the point, the tooth centroid.

The models presented are of a girl, aged four years and ten months, and six years and one month. The orthodontist will be able by eye to see the altered occlusal relations of the left buccal teeth. In the second model the mandibular molars appear to be mesial to their original positions (Fig. 8).

The mandibular graph (dotted line, aged four years and ten months) shows the arch form with the ten tooth centroids. The solid line a similar plot of second model (aged six years and one month). (Fig. 9.) (All maps shown are related by formula described in this paper.)

It will be seen that the growth between canine centroids has flattened the curve in front, the radius of the arcs (canine to canine) changing from a radius of 16.3 mm. to 24.9 mm., all the buccal teeth have moved forward, the arch has shortened.

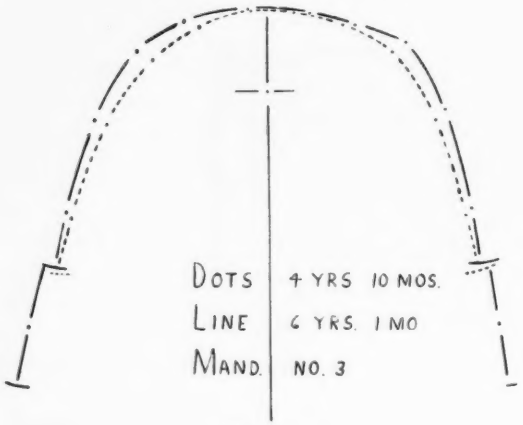


Fig. 9.

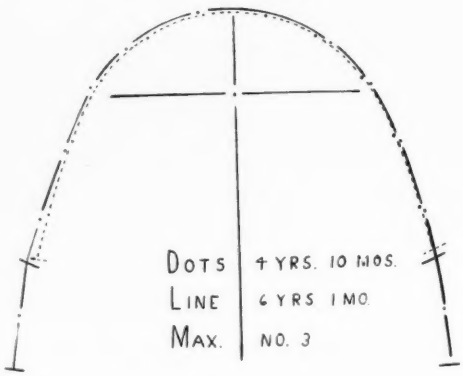


Fig. 10.

Fig. 9.—Mandibular map to show the effect on arch form and tooth movements due to growth between ages of four years and ten months and six years and one month.

Fig. 10.—Maxillary map to show the effect on arch form and tooth movements due to growth between ages of four years and ten months and six years and one month.

If we look at the maxillary graph, it appears to be an entirely different story, as the two curves appear to be more nearly what one would expect from a simple widening of the arch. *The side teeth all move relatively backward.* (Fig. 10.)

It would appear from a study of these graphs of this maxillary and mandibular growth that the growth changes were proceeding at different rates in the two jaws.

Table I compares the linear growth changes of maxilla and mandible from right to left.

Franke* after his study of many arches concluded the permanent incisors erupt behind the deciduous and the permanent arch lies relatively behind the deciduous as shown by his graph; evidently he related his graphs by drawing a line on the permanent dentitions at the mesial of the first permanent molars

*Ztschr. f. Laryng. u. Rhinol. 10: 187-391, 1922.

TABLE I

Lateral Growth One Year and Three Months (Four Years and Ten Months) to (Six Years and One Month)

	(Canine to Canine)	(M^1 Decid.)	(M^2 Decid.)
Maxilla	1.8 mm.	1.3 mm.	1.2 mm.
Mandible	2.5 mm.	1.6 mm.	0.8 mm.
Lateral Growth Next Ten Months to Six Years and Ten Months			
Maxilla	0.8 mm.	0.4 mm.	0.3 mm.
Mandible	0.1 mm.	−0.3 mm.	0.1 mm.

and registered this line on the distal of the second deciduous molars on the graph of the deciduous dentition.

Fig. 5 was prepared as follows: Nine normal dentitions, selected for wide range of arch form, were surveyed and related by centroid and axis. The ir-

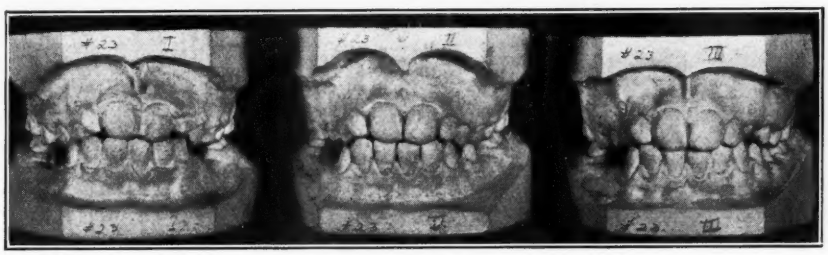


Fig. 11.—Left model at age eight years and three months. Center model at nine years and three months. Right model at ten years and three months.

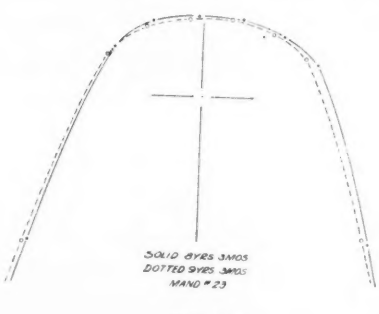


Fig. 12.

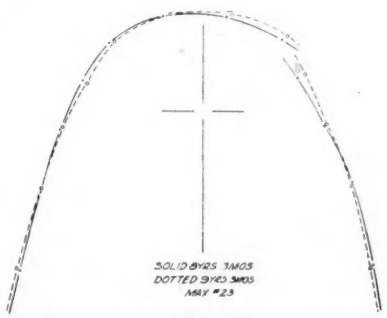


Fig. 13.

Fig. 12.—Mandibular map, case shown in Fig. 11, to illustrate change of arch form and tooth movements between ages of eight years and three months and nine years and three months.
Fig. 13.—Maxillary map of same case.

regular boxes were drawn just to enclose the various centroids of the mandibular teeth. Thus these boxes show the range of variation of the centroids of similar teeth for these nine normals.

Another map was prepared of six normal deciduous dentitions, and similar boxes were drawn around the centroids of the mandibular teeth and the two maps related as shown. While we have no formula to guide us in this relating of the two maps, still I feel it more accurately portrays the relative positions of the deciduous dentition to the permanent than any hitherto published graph. For in our studies of individual developments I find the permanent curvature in front follows closely the deciduous, the canines move radially forward—the arch shortens. I have satisfied all these conditions in relating the two graphs.

The next case presented is of a patient with malocclusion, left untreated with models taken at age eight years and three months, and nine years and three months, and ten years and three months (Fig. 11). The improvement in occlusion is shown by the shifting of the midlines between the incisors, and the relations of the teeth in the right canine region.

Fig. 14.—Upper model at five years and nine months. Lower model at six years and eight months. Premature loss of second deciduous molar. (X-ray picture shows M′ 4 mm. forward of its normal position before the loss of second deciduous molar whose distal root was prematurely absorbed.) Four months drift forward M′, after extraction of deciduous molar, 1.5 mm. Total mesial drift of M′ 5.5 mm.

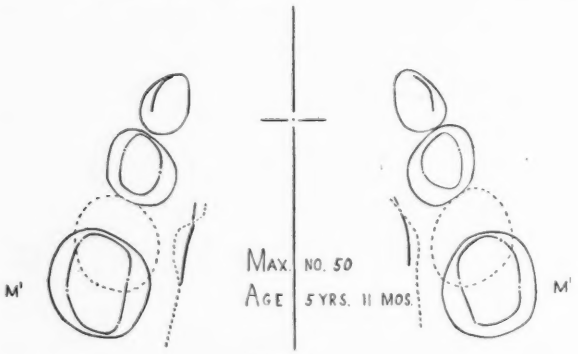


Fig. 15.

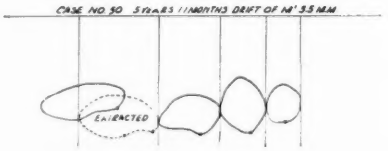


Fig. 16.

Fig. 15.—Horizontal map (maxillary) of case shown in Fig. 14, to illustrate forward drift of right and left M′. Dotted line represents the extracted second deciduous molars.

Fig. 16.—Vertical map to illustrate the forward drift and tilting of M′, same case as shown in Figs. 14 and 15.

It would be difficult to estimate by eye the relative tooth changes. The mandibular graph shows in solid line the conditions at eight years and three months, the dotted line at nine years and three months. All the incisors are moving to the left, the left canine is moving distally, the arch form on the left has little change, while on the right it moves to the left approaching symmetry with the left side (Fig. 12).

The maxillary graph shows an opposite change, the incisors are moving to the right, and the right arch form is progressing toward a more normal relationship with the mandibular arch form (Fig. 13).

The next case illustrates models of a boy aged five years and nine months, and six years and eight months. His last appearance at the clinic was July, at which time the maxillary first molars were unerupted. During the summer the mother reported that there was pain in the region of the first maxillary molars. A dentist advised the extraction of the second maxillary deciduous molars. This was done. The second model, taken four months after the July visit, shows the drift of the first molars during a period of less than four months (Fig. 14).

The horizontal graph of the two models is related by the described formula, shows the drift of the first molars due to the extractions (Fig. 15). The side elevation shows clearly the mesial drift and also the tilting of the first molars. (Fig. 16.)

I intended to add to this paper the drifts which occur at various ages when the first deciduous molars are prematurely lost. The time allotted would not permit. Suffice it to say that shifting varies greatly, i.e., sometimes the distal teeth move forward, in other cases the anterior teeth move back, while in some cases there is little or no change due to the premature extraction.

CONCLUSION

Some precise formula is required in order to relate graphs properly, of the same dentition at different age periods.

The formula presented seems to meet the required conditions.

At the present time we have insufficient evidence to guide us in determining whether we shall or shall not place space retainers for prematurely lost deciduous teeth.

The premature loss of the second deciduous molars, prior to the eruption of first permanent molars, is a most untoward event, producing in a few months pronounced malocclusions, which are preventable provided a suitable space retainer of the Willett type is placed on the day of the extraction.

SOME EFFECTS OF SOLDERING AND OTHER HEAT TREATMENTS ON ORTHODONTIC ALLOYS*

R. L. Coleman, B.S., Hartford, Conn.

SOLDERING always involves heating of the parts to be joined, and such heatings are, in a broad sense, heat treatments. In order to understand the effects of soldering, it is, therefore, necessary to understand the effects on the materials soldered of the various heat treatments to which they are likely to be subjected. Consequently, a study of soldering effects is largely a study of heat treatments.

It is well known that many gold alloys can be softened or hardened by appropriate heat treatments. The heat treatments usually recommended are, for softening, to heat the material to a dull red heat, usually specified as 1300° F., for about two minutes and immediately quench in water, and for hardening to reheat the quenched metal to below a red heat, usually to about 850° to 900° F., and cool it slowly from that temperature to about 480° F. over varying lengths of time, depending upon the alloy. For some alloys the length of time required or recommended is about thirty minutes, while for others it is only about three minutes.

A second method of hardening, which is sometimes recommended, consists of holding the work at a definite temperature or within a definite range of temperature for a given length of time.

Fig. 1 shows the hardening effect on two alloys, the compositions of which are given in Table I, of holding at various temperatures ranging from 1300° F. to 300° F. In determining these values all samples were first heated at 1300° F. for two minutes and quenched in water. They were then reheated at the various temperatures indicated for five minutes and again quenched. The hardness values for the samples as originally quenched from 1300° F. were the same as those for the samples reheated at 1300° F.; hence only one set of values for this temperature is shown in the graph. The hardness of these alloys "oven cooled" or cooled from 850° F. to 480° F. over a period of thirty minutes is also indicated in the graph in the upper right hand corner. The hardness values were determined with a dead load "Baby" Brinell machine using a 1/16 in. ball and a 12.8 kg. load.

It will be noted that Alloy 1, which is low in platinum group metals, was not hardened by heating at 700° F. or higher temperatures, although there was marked hardening at 650° F. The maximum hardening was at 600° F., and there was an appreciable hardening at as low as 300° F. Alloy 2, which contains 17 per cent total platinum group metals, was hardened appreciably at temperatures as high as 1200° F. The maximum hardening occurred at about 800° F., and at lower temperatures the effect decreased rapidly until at 500° F. it was practically negligible.

*Read before the New York Society of Orthodontists, New York, N. Y., March 14, 1933.

A comparison of the behavior of these two alloys clearly indicates one of the serious disadvantages of this method of hardening in practical laboratory procedure. Different alloys require heating at different temperatures; so in order to use this method successfully it is necessary to know the characteristics of each alloy employed, and adjust the temperature of the heat treatment accordingly. In cases where two or more alloys are employed in constructing a single appliance, as for example an arch wire of one alloy, auxiliary springs of another, and still other alloys used as solders, it frequently happens that no one temperature is suitable for hardening all of the alloys involved, and consequently the whole appliance would have to be subjected to several different heat treatments in order to obtain the desired result. For this reason, if it is desired to use a hardening heat treatment, it is much more convenient to use the slow cooling method in which each alloy automatically passes through its hardening temperature range and the whole appliance is hardened by the one operation.

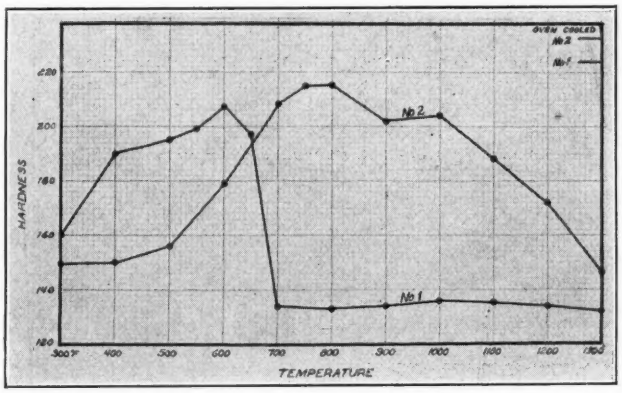


Fig. 1.—Hardening effect on two alloys of heating at various temperatures.

Although many technicians do not employ either of these methods or any other controlled hardening heat treatment in the construction of appliances, in the process of soldering the work is frequently held within or allowed to cool through its hardening temperature range. These accidental or incidental hardening heat treatments often have a marked effect on the properties and serviceability of the finished appliance. This is especially true of work which is soldered on a model or is invested for soldering, because in such cases the rate of heating or cooling is normally relatively slow, and, consequently, the work is within its hardening temperature range long enough for a considerable degree of hardening to take place. Overhardening by very slow cooling of invested work after soldering is a common cause of wire breakage.

The annealing or softening heat treatment previously described is generally employed in practice for the purpose of relieving strain hardness or the hardness caused by bending, swaging or other shaping operations. In the case of most gold alloys it is also effective for relieving hardness caused by a previous hardening heat treatment. The annealing temperature usually recommended is 1300° F. Heating to higher temperatures, as may occur in annealing over an open flame and in soldering, tends to soften and weaken the alloy still further.

This weakening effect is often accompanied by a decrease in ductility, especially if temperatures approaching the lower limit of the melting range are reached.

TABLE I

COMPOSITION (PER CENT BY WEIGHT)

ALLOY	1	2	3	4
Gold	63.0	62.0	–	55.0
Silver	12.0	8.5	39.1	7.0
Copper	20.0	11.0	16.7	11.0
Platinum	–	11.5	–	18.0
Palladium	2.0	5.5	44.2	7.5
Zinc	3.0	1.5	–	1.5

These effects are shown graphically in Figs. 2 and 3. In Fig. 2 the upper and lower curves represent the ultimate tensile strength and percentage elonga-

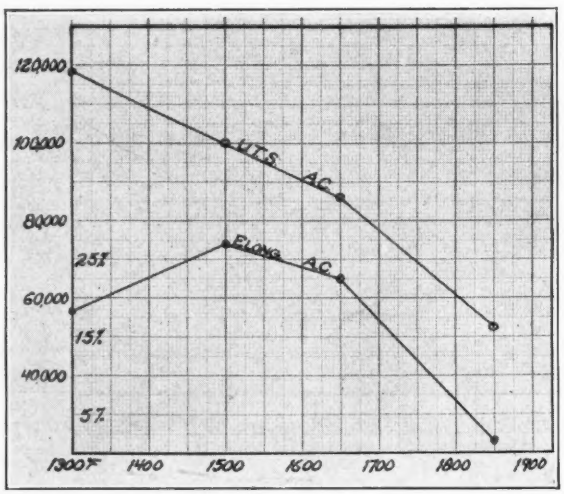


Fig. 2.—Effect on tensile strength and elongation of Alloy 3 of heating at relatively high temperatures.

tion in 2 inches, respectively, of samples of Alloy 3, after being heated at the temperatures indicated for two minutes and air cooled. Fig. 3 shows the same properties for Alloy 4 after air cooling, and in addition the tensile strength and elongation of the same alloy air cooled from the temperatures indicated and then hardened by slow cooling from 840° F. to 480° F. over a period of thirty minutes. The compositions of these alloys are given in Table I. Both are relatively high fusing wires, the fusion temperatures as determined by the "wire method" being 1900° F. for Alloy 3 and 1925° F. for Alloy 4.

Referring to Alloy 3, Fig. 2, it will be noted that the strength decreased very rapidly as the temperature to which the wire was heated increased. After the alloy was heated at 1850° F., the strength was less than one-half that of the wire air cooled from 1300° F. The elongation increased as the temperature was raised up to 1500° F. and then decreased very rapidly. After heating at 1850° F. the elongation was only 1½ per cent, and the wire was so brittle that it would withstand only a very small amount of bending without breaking.

Although Alloy 3 was purchased on the open market as a clasp wire and is being recommended as such by its manufacturer, as indicated by its composition it is not truly representative of this type of alloy. Its deterioration at high temperatures is greater than that of many alloys, and it may be considered an extreme example in this respect.

Alloy 4, Fig. 3, also loses strength when heated to high temperatures and air cooled, although this effect is not very pronounced. In the air-cooled condition the elongation was increased by heating at the higher temperatures up to 1850° F. After being air cooled from the higher temperatures and then given a hardening heat treatment the loss in strength was more marked. There was a perceptible loss after heating at 1750° F., and after heating at 1850° F. the loss amounted to about 13 per cent of the strength of the samples heated to only 1300° F. Up to 1750° F. the loss in elongation was small, but at 1850° F.

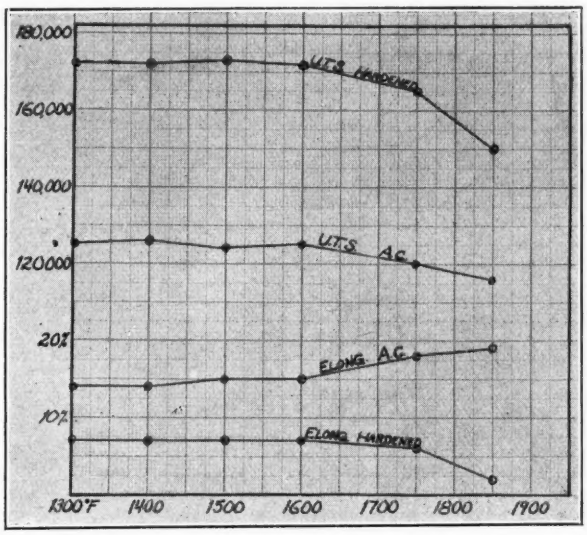


Fig. 3.—Effect on tensile strength and elongation of Alloy 4 of heating at relatively high temperatures.

it was quite marked. Alloy 4 is not truly representative of the clasp and orthodontia wires in general use as its deterioration at high temperatures is much less than for many of them. The two examples given here more nearly represent the extremes, and for most wires the degree of deterioration caused by heating at high temperatures will be somewhere between the two. This effect is of considerable practical importance because of the fact that in soldering the work must be heated to between 1500° F. and 1700° F. and frequently the temperature runs much higher, especially when a fine wire is being soldered with an intense needle point flame. Examination of a large number of defective soldered joints has shown that overheating during soldering is an important cause of wire breakage, especially when the soldered parts are allowed to cool slowly or are given a subsequent hardening heat treatment. While it may not be necessary to heat wires high enough to injure them in order to accomplish the necessary soldering, with the equipment now available it frequently is very difficult to avoid doing so. For this reason a number of careful and competent technicians prefer not

to employ a finishing hardening heat treatment so that they may avoid breakages resulting from brittleness caused by accidental overheating in soldering followed by such a heat treatment.

Accurate tests of mechanical properties such as those discussed in the preceding paragraphs, usually cannot be used to determine the effects of soldering operations on the parts of practical dental appliances because the size and shape of such parts are unsuitable. However, if the relationship between microstructure, mechanical properties and previous treatments of the alloys of which these appliances are constructed is known, it is possible to learn a great deal

Fig. 4. Fig. 5.

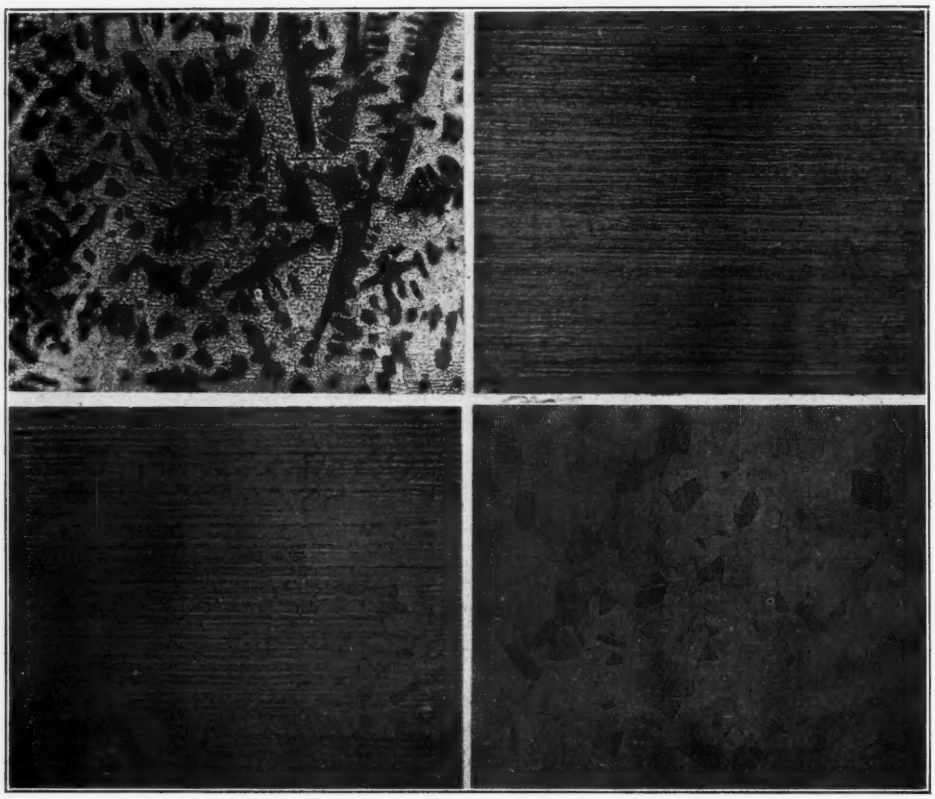


Fig. 6. Fig. 7.

Fig. 4.—Typical dentritic structure of cast ingot from which wire is made, original magnification ×100. Alloy 4.

Fig. 5.—Typical fibrous structure of drawn wire annealed, original magnification ×500. Alloy 4.

Fig. 6.—Structure of Alloy 4 after heating at 1750° F., original magnification ×500. Fibrous structure beginning to break up and grain growth starting.

Fig. 7.—Structure of Alloy 4 after heating at 1850° F., original magnification ×500. Fibrous structure completely gone. Metal coarse grained.

about the previous treatment and present condition of such appliances from an examination of their microstructure. Some progress has been made in determining these relationships, and, consequently, the microscope has proved of considerable value in determining the cause of failure of soldered parts.

The microstructures corresponding to various conditions of thermal and mechanical treatments of Alloy 4 are shown in Figs. 4 to 7 inclusive. Fig. 4 shows the crystalline structure of the cast ingot from which wire is made.

The irregular dark patterns represent the dendrites or incomplete crystals which are formed as the molten metal freezes in the ingot mold. This structure is more or less typical of most alloys of this class in the cast condition. As the cast ingot is rolled, swaged, or drawn into wire, the dendrites are deformed and stretched out to form the fibrous structure shown in Fig. 5. This worked, fibrous structure is typical of wire that has not been heated to very high temperatures after the final drawing.

In studying the structure of wire of Alloy 4 corresponding to the various heat treatments indicated in Fig. 3, no significant change in the typical fibrous

Fig. 8. Fig. 9.

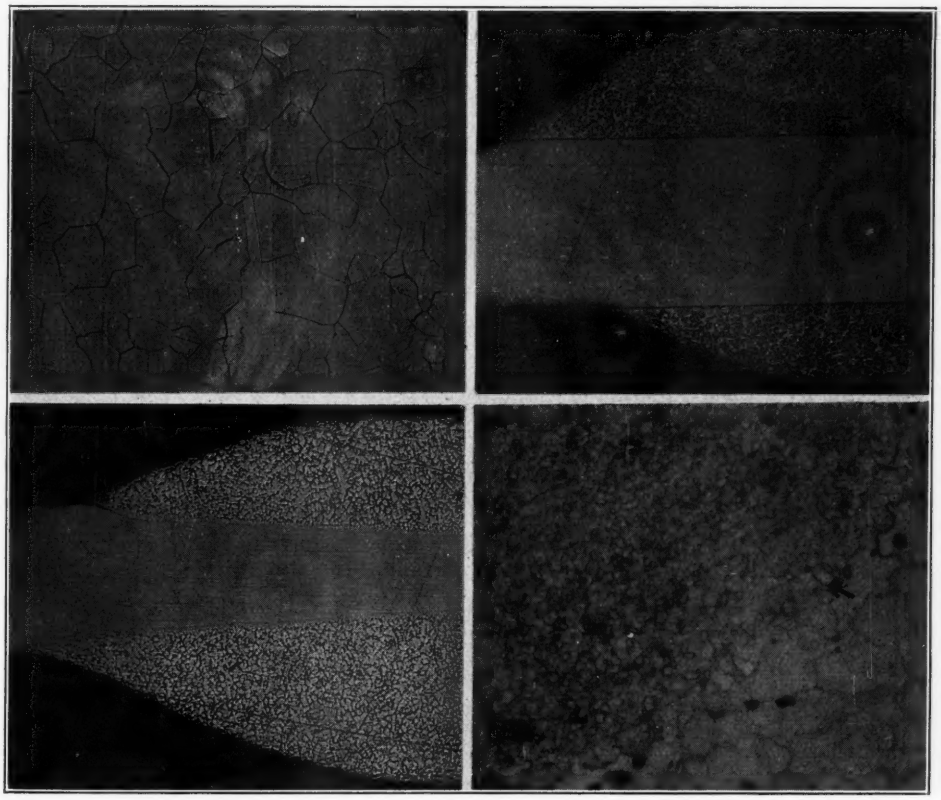


Fig. 10. Fig. 11.

Fig. 8.—Structure of lower fusing wire (fusion temperature 1700° F.) after heating at 1650° F. Very coarse-grained and brittle.

Fig. 9.—Wire on which solder was flowed, original magnification ×30. Mechanical union only.

Fig. 10.—Wire on which solder was flowed, original magnification ×30. Excessive solution of wire in solder.

Fig. 11.—Cross-section of wire on which solder was flowed, original magnification ×200. Showing solder continuing growth of grain in surface of wire.

structure was noted until the temperature to which the wire had been heated reached 1750° F., when the structure was as shown in Fig. 6. The fibrous structure is still apparent but is beginning to break up; the distorted and elongated crystals are beginning to rearrange themselves more nearly in accordance with their normal shape. As shown in Fig. 3, this change in structure is accompanied by a slight loss in strength. After heating at 1850° F. the structure was as shown in Fig. 7. The fibrous structure has almost completely disappeared, and

the recrystallization is quite pronounced, the metal having become relatively coarse grained. The wire in this condition showed a marked decrease in strength, and after being hardened, a decrease in elongation. The temperatures at which these changes take place will vary somewhat with the time the temperature is maintained, a slightly lower temperature producing about the same change if it is maintained a longer time. The temperatures also vary considerably for different alloys. As an example of this, Fig. 8 shows the very coarse-grained structure of a medium fusing clasp wire (fusion temperature about 1700° F.), after heating to only 1650° F. This wire also was found to have lost strength after receiving this treatment, and after receiving a subsequent hardening heat treatment was extremely brittle. Similar changes in structure with corresponding changes in mechanical properties caused by heating to high temperatures have been found to occur in a number of other wires too numerous to describe in detail here. It is believed to be a safe conclusion that a clasp or orthodontia wire exhibiting this type of coarse-grained structure has been heated to a relatively high temperature and usually, though perhaps not always, has suffered a deterioration in mechanical properties.

The effect of the molten solder on the soldered parts may have a marked influence upon the strength of the finished appliance, as shown in Figs. 9 and 10. Fig. 9 shows a longitudinal section through a wire on which solder has been flowed with a blowpipe. As soon as the solder flowed, the flame was removed. Fig. 10 shows a corresponding section through a duplicate piece of wire on which the same kind of solder was flowed in exactly the same way except that after the solder had flowed it was kept molten for about one minute before the flame was removed. In both cases the wire and solder were well protected with flux. In the first case the union between the solder and the wire appears to be entirely mechanical. In the second case the wire was partially dissolved by the molten solder, the action being similar to that of molten gold on a piece of solid platinum, for example. If a piece of solid platinum is placed in a crucible of molten gold it will dissolve in the gold and become liquid even though the temperature is maintained well below the melting point of platinum. In the same way a relatively high fusing wire will dissolve in molten solder. Generally speaking the longer the solder is kept molten the greater the amount of solution will be. The amount of solution also increases as the temperature is raised above the melting point of the solder. For example, it has been demonstrated that a solder, the upper limit of the melting range of which is 1430° F., will dissolve a given wire faster when heated to 1600° F. than will a solder, the upper limit of the melting range of which is 1590° F., when heated to 1650° F.

It has been suggested that some solution of the soldered parts in the solder is necessary to insure a close union and a strong joint. There is evidence that this almost certainly is not universally true, and it is doubtful whether it is generally true. This will be referred to again in the discussion of Fig. 11. It is quite certain that a large amount of solution is injurious in that it materially weakens the soldered part at the edge of the solder. This is obvious from an inspection of Fig. 10. A part of the wire has been replaced by solder, or an alloy of the solder and the wire, yet at the edge of the solder the diameter is no greater than that of the original wire. Since the wire, being worked metal, is

stronger than this unworked metal with which it is replaced, it is evident that the appliance has been weakened at this point. The fact that in many appliances the maximum stress to which the wire is subjected occurs at the soldered joint is an additional reason for using great care to avoid weakening the appliance at this point.

Obvious precautions to be observed in order to minimize the injurious effects of overheating the soldered parts and of excessive solution of the parts in the molten solder are:

(1) Thoroughly clean the surfaces of the parts to be joined and keep them and the surface of the solder clean by using a suitable flux and a reducing rather than an oxidizing flame.

(2) Use a solder, the upper limit of the melting range of which is well below the fusion temperature of the wire, and which flows readily when melted. Experience indicates that a minimum spread of 150° F. between the upper

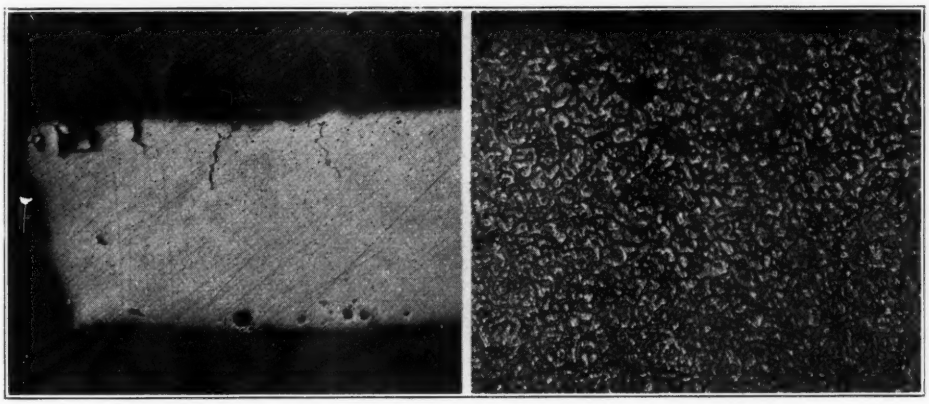


Fig. 12. Fig. 13.

Fig. 12.—Soldered wire that broke in service, unetched, original magnification ×35.
Fig. 13.—Same wire as shown in Fig. 12, etched, original magnification ×200. Solder has completely dissolved wire.

limit of the melting range of the solder and the fusion temperature of the wire is usually safe practice.

(3) Avoid heating the work to temperatures higher than necessary or maintaining the high temperatures longer than necessary.

Referring again to the mechanics of a strong soldered joint, the condition illustrated in Fig. 11 seems worthy of note as it has been observed in a number of soldered joints of practical appliances. The figure shows a cross-section of a round wire on which solder has been flowed. There is no apparent solution of the wire in the solder. At the point indicated by the arrow there is a grain which apparently lies partly in the wire and partly in the solder. A possible explanation of this is that grains at the surface of the soldered part may serve as nuclei of grains forming in the solidifying solder, the solder in freezing continuing the growth of the grains already present at the surface of the wire. This would appear to be the ideal type of joint as the solder and wire become practically one solid piece of metal without the weakening effect of any solution of the wire in the solder.

The preceding micrographs show the structure of various alloys corresponding to known mechanical and thermal treatments. Figs. 12 to 17 inclusive show the appearance under the microscope of some typical practical cases and serve to illustrate how the previously established correlation between structure, mechanical properties and previous treatments may be applied in diagnosing the causes of failures of cases which have been subjected to unknown or uncontrolled treatments.

Fig. 14.

Fig. 15.

Fig. 14.—Soldered clasp wire that broke in service, unetched, original magnification ×35.
Fig. 15.—Same wire as shown in Fig. 14, etched, original magnification ×100. Coarse-grained metal caused by overheating in soldering.

Figs. 12 and 13 show a longitudinal section near the fracture of a wire which failed in service at the soldered joint. Fig. 12 shows the appearance of the wire polished but not etched. Numerous blowholes and cracks, which should not be present in wrought wire, are apparent. There is no line of demarcation between the solder and the wire. Fig. 13 shows the same section at a higher magnification after being etched. The magnification is too high to show the full diameter of the wire in the photograph, but under the microscope it was seen

that the structure shown was uniform throughout the section. This indicates that this section of the wire was completely dissolved by the molten solder, in effect being converted from wrought wire to cast metal. Unquestionably, this is the cause of the failure.

The solder used in the above case was found by analysis of a separate sample to contain gold 80 per cent, zinc 10 per cent, and nickel 10 per cent. Although it is relatively low fusing and high in precious metal content, it oxidizes badly

Fig. 16.

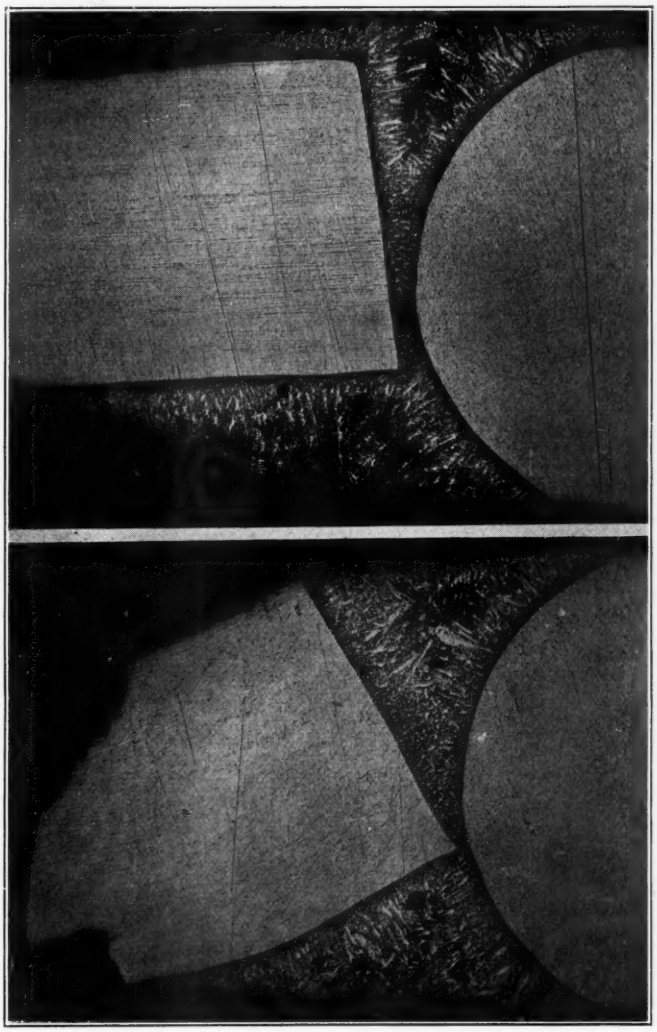


Fig. 17.

Fig. 16.—Finger spring soldered to arch wire, original magnification ×100. Good joint which gave good service.

Fig. 17.—Finger spring soldered to arch wire, original magnification ×100. Finger spring broke during adjustment due to too severe bending without annealing.

when melted, and the nickel oxide especially is very difficult to reduce or flux off. Consequently a film of oxides forms on the surface of the solder and prevents it from flowing readily. It is necessary to heat it well above its melting point and for a relatively long time in order to make it flow. Obviously the use of such a solder, even though it is low fusing, is more likely to injure the wire than a higher fusing solder which flows readily as soon as it is melted.

Figs. 14 and 15 show a longitudinal section of a wire clasp on which an occlusal rest was built up by flowing solder over a 24K. matrix and against the wire. This wire broke in service at the edge of the rest. The wire and solder used are the same as those discussed in connection with Figs. 12 and 13. In this case the solution of the wire in the solder does not appear to be excessive, but the fact that the wire was heated to a relatively high temperature or for a

Fig. 18.

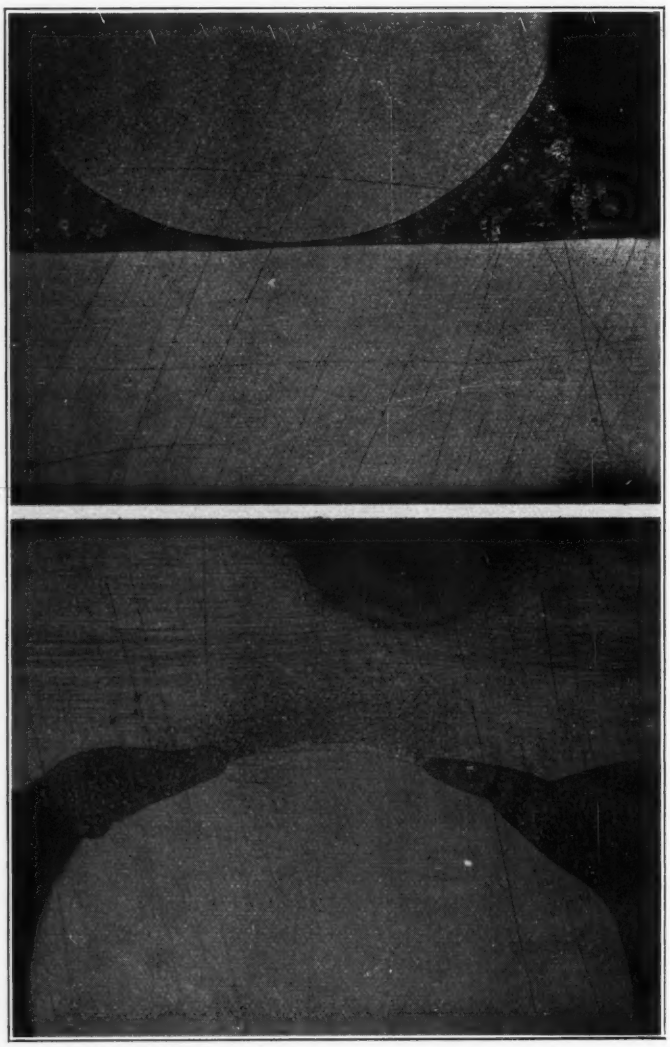


Fig. 19.

Fig. 18.—Finger spring soldered to arch wire with spot soldering machine, original magnification ×100. A good joint except for melting of wire by electrode.

Fig. 19.—Finger spring soldered to arch wire with spot soldering machine, original magnification ×100. Excessive solution of wire in solder. Wire melted by electrode.

long time is indicated by the coarse-grained structure shown in Fig. 15. It is reasonably certain that this was the cause of failure.

Fig. 16 shows a cross-section of an arch wire and a longitudinal section of a finger spring soldered to it. This is from an appliance which had given good service and was discarded only upon completion of the treatment. The fibrous structure of the wires indicates that neither of them was overheated in annealing

or soldering. There is no apparent solution of either wire in the solder. Such a joint would be expected to give good service.

Fig. 17 shows a similar joint in another appliance. Again the wires were not overheated and excessive solution of the wires in the solder is not apparent. Yet in this case the finger spring broke during adjustment. From the curvature of the fibers of the finger spring it is evident that it was given a gradual bend in one direction and then a sharp bend in the opposite direction. It seems probable that breakage was caused by this severe reverse bending without inter-

Fig. 20.

Fig. 21.

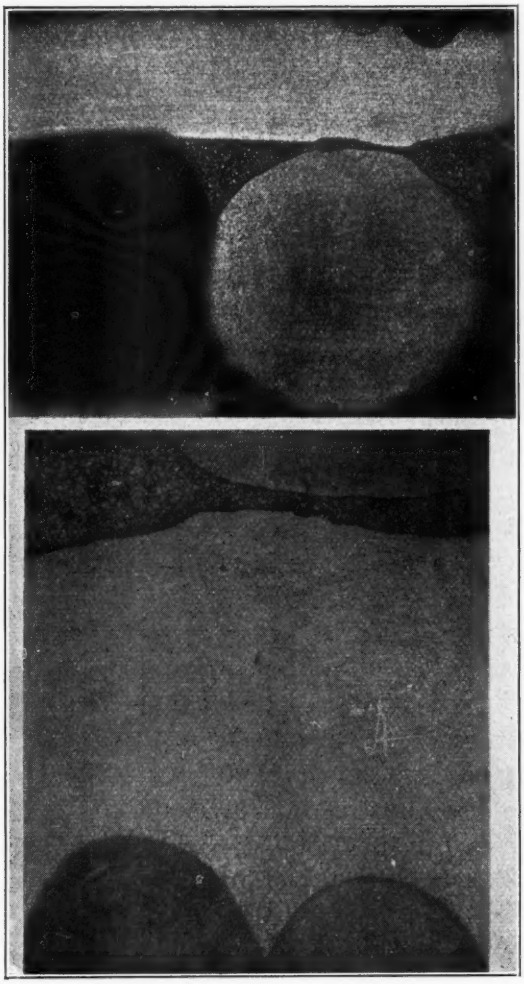


Fig. 20.—Finger spring soldered to arch wire with spot soldering machine, original magnification ×50. Some solution of wires in solder. Wire melted by electrode.

Fig. 21.—Same joint as shown in Fig. 20, original magnification ×200. Shows that metal at electrode contacts was melted and adjacent metal was heated high enough to cause grain growth.

vening annealing. It is also possible that if the spring was attached to the arch wire on a model and allowed to cool on the model after soldering, the resulting slow cooling may have overhardened the wire and made it too brittle to stand a sharp bend. In either case it is probable that annealing the wire before attempting the sharp bend would have prevented the breakage.

Through the courtesy of Dr. Charles A. Spahn a series of soldered joints made with an electric spot soldering machine was made available for examina-

tion. The series includes joints made with several different wires and with three grades of solder, 22K., 18K., and 14K. Little significant difference in the behavior of the different wires or the different grades of solder was observed. For this reason, and in order to conserve space, only three typical joints are shown.

Fig. 18 shows a spot soldered joint in which 22K. solder was used. At the point of contact of the electrode with the finger spring, shown in the lower right-hand corner of the figure, the wire was slightly melted. Otherwise the joint appears to be very good. The main body of the wires was not overheated, and there is no indication of excessive solution of the wire in the solder. This is the best of the whole series of spot soldered joints examined, although it is probable that at the point of contact of the electrode the wire was appreciably weakened.

Fig. 19 shows a second joint also made with 22K. solder. Marked solution of both wires in the solder is evident. The electrode melted deeply into the finger spring. At the point of contact between the arch wire and the spring, the spring was severely overheated, perhaps because of a small arc caused by a poor initial contact between the two wires. The extremely localized nature of the heating is evidenced by the fact that the lower section of the finger spring was melted and the opposite side was severely overheated, yet the center of this 0.022 inch wire was not heated sufficiently to break up the original fibrous worked structure. It seems certain that such a joint could not stand up in service if the working stresses were at all severe.

Figs. 20 and 21 show another joint, made with 18K. solder. In Fig. 20 solution of both wires in the solder is apparent and the finger spring shows two electrode contacts. Fig. 21 shows the same joint at a higher magnification. At the electrode contacts it is evident that the metal was not displaced but was simply melted and remained in its original position. Adjacent to these contact points the wire was heated sufficiently to cause marked grain growth.

While it is doubtful whether any of the spot soldered joints examined would give satisfactory service, this is not to be considered a condemnation of this method of soldering. The method has the obvious advantage of localizing the heat at the joint, the rest of the wires remaining unaffected. It is entirely possible that if the machine can be fitted with suitable electrodes and if a technic for controlling the temperature can be developed, the method may be made to give entirely satisfactory and perhaps superior results.

DISCUSSION

Dr. Spahn (Introductory).—While at the International Dental Congress in Paris in 1931, we observed a spot-welding machine, which was constructed in a very delightful form, so far as its use in an orthodontic office is concerned. In France, it is used mostly for the welding of stainless steel; and the thought occurred to several of us that if it could also be used for gold, it would make a wonderful technical machine in attaching finger springs and in soldering operations.

When we returned to America (I say "we" because there were two or three of us interested), the suggestion was made that we investigate this problem, and I personally went to the Eisler Electric Company in Newark, New Jersey, which is prepared to make these machines and also to do all kinds of spot-welding, as they deal with jewelry and electrical supply concerns, etc.

After considerable time had been spent there, it was decided by the Clinic Committee of the New York Society of Orthodontists to have an exhibition given before our Society, which was accomplished, I believe, on two occasions at a considerable expense to the Eisler Electric Company. A large number of men appeared interested in this form of soldering.

We made joints and experimented considerably with standard wires of known quality, but were unable to foresee what the joint would do under usage; nor could we tell in just what state the wire was at the soldering point. Therefore, one of the clinic committees decided that if these joints could be scientifically investigated, sections made, etc., it would be a wonderful thing to see upon the screen.

We tried to have this work done, but were unable to contact with the proper individual until Mr. Coleman became interested in the matter. He is an expert at this type of work and is perfectly capable of investigating materials of this kind in a scientific manner, having been trained at the Bureau of Standards in Washington. The problem was put before him and he consented to do this work (of which, I understand, he has slides and pictures).

What I have seen to date is very interesting, especially so to me because I have done some soldering work myself.

There is nothing more to add except that I am looking forward to comparing my solder joints with those that I believe Mr. Coleman will show, which were soldered by means of a regular gas blowpipe.

Dr. W. H. Crawford.—It gives me a great deal of pleasure to have the opportunity of discussing Mr. Coleman's paper because I am so sincerely interested in finding out something about how to manipulate and use dental materials. Mr. Coleman, I think, is one of our very best authorities on the use of practically all our dental materials.

I am in complete accord with what he has said. The investigations on wrought wires which we have been conducting at Columbia University are almost identical with the data which he has presented, secured from a different source.

I wish to emphasize the point which he brought out about the two different methods of hardening the gold alloys. One is by cold working and one is by a suitable heat treatment.

TABLE I

PHYSICAL PROPERTIES OF WROUGHT GOLD ALLOYS

ALLOY	ELASTIC LIMIT			ULTIMATE TENSILE STRENGTH		
	AS RECEIVED	QUENCHED[1]	OVEN[2] COOLED	AS RECEIVED	QUENCHED	OVEN COOLED
	LB./IN. SQ.			LB./IN. SQ.		
A	109,500	73,000	77,000	132,000	105,500	118,000
B	91,500	78,500	117,000	120,000	106,500	164,000
C	110,000	90,000	134,000	142,000	121,500	174,000
D	120,500	83,500	131,500	161,000	119,000	173,000
E	112,500	84,500	135,500	135,500	117,500	178,000
F	107,500	84,500	140,500	143 500	120,000	184,000

[1]Placed in furnace at 700° C. for ten minutes, immediately quenched in water at room temperature.
[2]Oven cooled 450-250° C. in thirty minutes after quenching as above.

Table I is a list of physical properties of various alloys which you may have seen. It* was published by the American Dental Association Associates at the Bureau of Standards, and it shows the elastic limit and ultimate tensile strength of a number of different commercial wires which they tested. You will see by examining the first column of figures in Table I the elastic limit of the wires as they were received from the manufacturer. The first one shows an elastic limit of 109,500 pounds per square inch as received; but just as soon as the cold working was relieved by a suitable heat treatment, this property dropped to 73,000, a considerable reduction. Slow cooling in an oven failed to restore the strength

*Paffenbarger et al.: Wrought Gold Wire Alloys, J. A. D. A. 19: 2061.

of that wire very much, and you will see by examining all the figures presented here, that in every case the wire was softened by heating to a suitable temperature followed by quenching.

The application of that is, I think, that wires, when we receive them, are in many cases loaded with work hardening which cannot be used because just as soon as we solder the wire, it is heated to a temperature which will relieve cold working; consequently it is useless to us to receive wires which are hardened by cold working.

We are deceived frequently with our thumb test in feeling that a wire is strong and resilient because it so appears to us from the sample which we get from the manufacturer, but just as soon as we heat the wire to soldering temperatures, that cold working is lost, and it is impossible to have it returned except by further cold working, and of course that is impossible.

The other point to which I would like to call your attention, and one which was emphasized by Mr. Coleman, is the fact that as wires are heated to soldering temperatures a con-

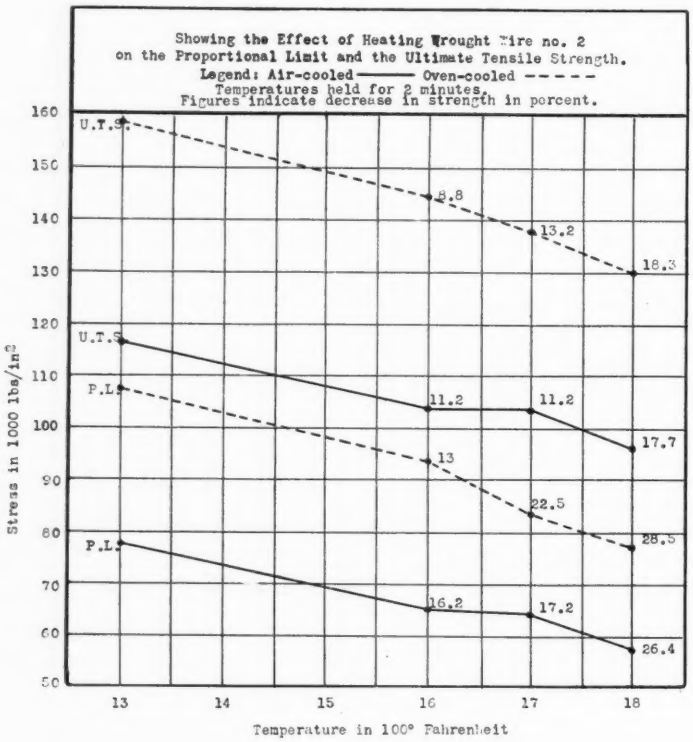


Fig. 1.

siderable loss of strength occurs. The graph in Fig. 1 shows the drop in the proportional limit and ultimate tensile strength in a wire commonly used for orthodontia arches and springs when it is heated to temperatures corresponding to those received in soldering. The physical properties of the wire as shown by the manufacturer's tables are indicated along the vertical line at 1300° F., these figures representing the strength of the wire in thousand pounds per square inch. Just as soon as the wire is heated to 1600° F., the proportional limit and the ultimate strength have dropped considerably. As the temperature to which the wire is heated continues to rise, the strength of the wire continues to decrease.

The application, I feel, was very well brought out by Mr. Coleman in this respect, and that is that where a wire is soldered it is heated to a much higher temperature than it is in other positions on the wire, and consequently, the wire at and near the solder joint is weaker than it is elsewhere on the arch. Accompanying this is the fact that at the solder joint there is a greater stress than elsewhere. These two factors are accountable, at least in part, for breakages occurring at or near solder joints.

TABLE II

SHOWING EFFECT ON DUCTILITY OF HEATING WROUGHT GOLD ALLOY

HEAT TREATMENT	PERCENTAGE OF ELONGATION	PERCENTAGE OF REDUCTION IN AREA	COLD BENDS
Q[1]	16.0	65.7	5½
Q 1300 – 2′ AC[2]	10.75*	48.1	4
Q HT[3]	12.0	41.2	2½
Q 1600 – 2′ AC	24.0	57.4	4⅔
Q 1700 – 2′ AC	19.25*	59.7	4⅔
Q 1800 – 2′ AC	26.5	56.8	4¼
Q 1600 – 2′ AC HT	10.5	30.9	1¾
Q 1700 – 2′ AC HT	12.25*	37.8	1½
Q 1800 – 2′ AC HT	9.5	14.2	¼

[1]1300° F. for two minutes and quenched in room-temperature water.
[2]Air cooled.
[3]Cooled in oven from 840° F. to 480° F. in fifteen minutes.
*Broke outside gauge marks.

Table II shows the effect of heating to soldering temperatures on the property of ductility. It will be noted that the wire when not heated over 1300° F. is very ductile, as indicated by percentage of elongation, percentage of reduction in area and cold bends. However, when higher temperatures are employed, it will be noted that ductility decreases rapidly where the heating is followed by a slow cooling heat treatment. It is true that the slow cooling will increase the strength, but this increase is of no value if the ductility is lost. I should like to call your attention to the ductile properties of this wire when it has been heated to 1800° F. and followed by slow cooling. The wire is so brittle that it will break when subjected to one quarter bend (which is a 45° bend over a rounded edge). You will note also that in this brittle condition the wire shows a 9.5 per cent elongation, which indicates that the percentage of elongation cannot always be relied upon to show ductility. The reduction in area here seems to be a more reliable guide.

The effects which we have secured on soldered joints are so similar to the ones which Mr. Coleman has that there is no need for me to show any. I should like to summarize a few deductions to be made from these investigations. First, soldering should be accomplished by heating to the minimum temperature necessary to cause the solder to flow. Second, special attention should be given to soldering operations so as to reduce the possibility of overheating. The parts to be soldered should be well cleaned with a disk to remove all oxides and débris. They should also be well fluxed at low temperatures to prevent oxidation during heating. The solder should be clean and well fluxed.

Note that the strength properties may be 20 to 30 per cent less after soldering temperatures have been reached than are advertised. Ductility of wires is reduced by heating to soldering temperatures followed by slow cooling, even to the extent of extreme brittleness in some cases. Slow cooling may be done unintentionally, which will produce the same result as when intentionally employed. The effects of slow cooling may be more disadvantageous than advantageous.

DEPARTMENT OF
DENTISTRY FOR CHILDREN

TEETH AND THE DIET*†

JULIAN D. BOYD, M.D., IOWA CITY, IOWA

DURING the past thirty years rapid advances have been made in the field of nutrition. Although much remains to be established, the available knowledge has increased our insight concerning the cause of disease and has raised doubt as to the adequacy of certain conclusions which have been generally accepted. It now is recognized that the nutritional needs of the body are surprisingly complex, that the effects of deficient diet may assume diverse forms, that malnutrition is no respecter of economic status, and that an individual may appear to eat an adequacy of food yet show definite evidence of malnutrition. It is known that inadequacies of diet can give rise to a variety of clinical syndromes; some are of minor significance while others are incompatible with life. There is evidence to indicate that increasing degrees of health and vigor can be attained by the individual who already appears well, if the diet is made more complete in its various essential factors.

Tooth decay is one of the commonest disorders encountered in the human being. Children seem especially susceptible, and it is not uncommon in some localities to find 95 per cent of the school children afflicted with this disease in varying degree. For about forty years it was believed generally by the members of the medical and dental professions that dental caries was dependent upon the destructive action of bacteria and their growth products. The standard procedures employed by the dental profession are based on this premise. For the past fifteen years, there has been a growing conviction that diet plays a larger rôle in the susceptibility of teeth to decay than the bacterial theory would grant. Much evidence has been accumulated to show that the use of various types of dietaries will lead to dystrophy and to caries of teeth of animals. About eight years ago some observations were made at the University of Iowa, indicating that diet can prevent or arrest caries if suitable inclusions are made. It was noted that when children with diabetes mellitus were placed on the usual régime for the treatment of that disease, a change occurred in their carious teeth, resulting in hardness of the exposed dentine and complete inactivation of all decay. This change occurred within eight to ten weeks after the child had been placed on strictly regulated diet, and the teeth were immune

*From the Department of Pediatrics, College of Medicine, State University of Iowa.

†A paper delivered at the annual joint meeting of the American Association of Medical Milk Commissions with the Certified Milk Producers' Association of America, at Milwaukee, Wis., June 11, 12 and 13, 1933.

to further decay as long as the prescribed régime was followed. Children with other metabolic disorders requiring adherence to a prescribed dietary responded similarly, even though the constituents of their diets were quite different from those of the children with diabetes. It then was found that arrest and prevention of caries could be obtained in practically any child, ill or well, if the regular ingestion of a complete diet could be enforced. These studies have been repeated and confirmed in numerous clinics in this country, and the conclusions now are quite generally accepted as proved. In each instance, the prescribed diets have been designed to be as complete in the recognized essentials for normal nutrition as knowledge will permit. While they have consisted in the main of foods commonly used, the dietaries are higher in their content of the so-called "protective factors" than diets usually employed in the average home. The attempt made by various workers in this field to ascribe the favorable effect on the teeth to sundry specific dietary components has served to confuse the issue. It seems most probable that the integrity of the tooth, as well as that of the other tissues of the body, is dependent upon the completeness of the diet in all essentials. In individual cases, the deficiency might be of one type, or of another, or possibly multiple in nature. Even though it were established that in certain individuals or groups of individuals some specific dietary deficiency led to decay of the teeth, it would not be justifiable to conclude that in all instances the deficient constituent was the one most important in protecting teeth from decay.

Granting that tooth decay is dependent upon deficiency of diet, the high incidence of dental caries indicates that there is a correspondingly widespread inadequacy of the dietaries of most civilized races. It also is apparent that this manifests itself more in childhood than in later life. There are other evidences that this conclusion is correct. It has been noted by various observers that the incidence of caries is lower in many orphanages than in corresponding groups of public school children, and that this seems to parallel the enforcement of a standardized dietary. The more expert the formulation of the diets and the more rigid their administration, the better the dental condition of the members of the group. Foreign groups showing high resistance to dental caries in their native environment will maintain sound teeth following migration to this country, as long as their previous dietary habits are maintained; when they adopt our local food habits, the incidence of decay increases rapidly.

Without question, the economic status of any group will determine in some measure the adequacy of the diets of its members. This is not sufficient to explain the widespread evidences of malnutrition which show themselves in varying degree in all levels of society. The lack of familiarity with ideal standards of nutrition, and with the components needed by the body for its perfect functioning, is the basic cause for this condition. There is a strong inherent tendency for each individual to assume that his food habits are derived from an instinctive knowledge of his body's needs. When his self-chosen diets are analyzed critically, very often they are found to be markedly lacking in many of the requisites for normal nutrition, and their recipient may exhibit various evidences of such deficiencies.

At present, there is an awakening appreciation of the part played by diet in health maintenance, and many people are eager to receive information to guide them in this matter. Inspired propaganda is being offered for this purpose through every medium of dissemination. Too often the information one gains is obtained from advertisements of food manufacturers or from similarly biased sources, designed to exploit certain products rather than to convey knowledge. Without a proper sense of proportion and a background of nutritional science, one would gain the impression from reading such material that a suitable diet cannot be obtained without the use of various proprietary foods and pharmaceutical preparations. To combat such pernicious exploitation and other forms of food quackery, it is necessary that members of the medical and allied professions keep themselves abreast with the recognized advances in this field.

According to the evidence now available, there are over thirty-five recognized food essentials which must be ingested for the proper functioning of the body. There is much to indicate that additional factors may be added to this list as our knowledge is increased. These necessary dietary components include proteins of such nature that they provide certain specified amino acids; dextrose as such or as a precursor, certain fatty acids, several types of substances termed vitamins, and various inorganic salts. The foodstuffs furnishing these elements of diet must be supplied in a palatable, assimilable form, in amounts and proportions suitable to promote optimum health. A diet may partially meet these requirements, and be compatible with life, but not with health; a diet more complete, yet lacking in some regards, may bring the health of the individual within the usually accepted zone of normality, yet not supply sufficient amounts of the necessary substances to permit him to be at his best; the complete diet may offer him a degree of health and of well-being of a decidedly superior degree. The attainment of the optimum, not the average, should be the goal.

In the conduct of studies designed to determine the adequacy of various dietaries, numerous methods of investigation present themselves. A simple clinical method is to record accurately the types and amounts of foodstuffs an individual ingests during a period of several days, then determine from the available tables of the composition of foods the amounts of the recognized essentials that have been supplied. A more accurate but likewise more laborious method is to feed a standard diet, and compare the chemical analysis of equivalent menus with the analysis of the excreta. In this manner, it can be determined whether the intake is sufficiently large in its various factors to offset the outgo, and the utilization of various forms of foodstuffs can be compared. Using a different approach, diets of varied but controlled composition may be fed to animals throughout a whole or a part of their life cycles, and the growth in length and in weight, the age at maturity, the duration of the period of active life, the normality of reproduction and of other body functions, can be determined and compared with available standards obtained similarly. Still another method of procedure is to correlate various physical traits of the human being with the type of dietary habitually employed.

Much of the available dietary information has been derived from data obtained by these methods. For example, surveys of the usual national dietaries

of the English and American people indicate that deficiency of vitamin D is not infrequent; inadequacy of supply of vitamin A, and less frequently of vitamin C, may be prevalent in varying degree. Many of the diets in common use furnish decidedly less calcium than is needed for proper nutrition. Deficiency of iron and of iodine is not uncommon. The adult can withstand faulty diets more safely than can the child; yet the planning of the menu frequently is done with the adult members of the family receiving first consideration, the children being deprived of the elements needed for proper growth and development. The use of milk is a case in point. Metabolic balance studies indicate that the child needs approximately a gram of calcium daily in order to satisfy properly the requirements for normal growth. Of the calcium-containing foods, milk is unique in its content of this mineral, its proportion to phosphorus, its assimilability, and the large amount of the food that can be taken daily, either as milk or as one of the products made from milk. There are dependable data to indicate that a child needs a quart of milk each day. Yet one's contacts with children in school, or in outpatient clinics, indicate that the use of a quart of milk per day per child is not at all common. In addition to its merits as a source of calcium and phosphorus, milk supplies a protein of high biologic value; and if milk is used in the amounts recommended, it will furnish a significant part of the daily protein requirement. It has been said that milk also is one of the most useful sources of vitamin G. Various observers have reported the improvement noted in the level of health, when the customary diet of the average school child is supplemented with further amounts of milk. It must be emphasized that in such children there may be no outstanding clinical evidence that supplementary feeding is needed. In an interesting study reported by Sherman and Booher, it was found that rats on diets containing reduced amounts of calcium may not necessarily appear inferior to their litter mates receiving an adequate supply of this element; yet analyses of the bones of members of each group showed that those on the lower calcium diets did not acquire the amount of lime found in the skeleton of the well-fed young adult rat until a much longer period had elapsed. If conclusions from this study can be carried over to the child, as would seem justifiable, then the child who receives less than the required quota of milk during childhood may be expected to enter maturity with ossification of poorer quality than his more fortunate companion. It is reasonable to suppose that other alterations in the normality of tissues, possibly difficult of detection, may arise from similar inadequacy of calcium or of other necessary dietary constituent. To what extent various pathologic conditions now considered as degenerative may be dependent upon masked deficiencies of the diet remains to be established.

A most interesting series of observations pertaining to this problem has been reported by McCarrison. Working in India, he was impressed by the peculiarities of health which characterized various Indian tribes. One district produced unusually well-developed individuals, long lived and free from most diseases. Other tribes were less fortunate, certain defects of physique or types of disease appearing preponderant in some groups; while other groups living under similar geographical conditions would manifest different types of pathologic conditions. With the belief that possibly these differences represented

the response to the dietary employed by each tribe, he studied the response of rats to each type of diet in common use. Thousands of rats were used in his studies. Each came from a common stock, of similar heredity. Each was observed and measured carefuly from the time of birth until its death. He found that the rats receiving the dietary of the superior tribe were free from physical disease, had a long span of life, and a mortality rate which was remarkably low. Careful postmortem examination of the rats dying of old age failed to reveal any noteworthy degree of degenerative disease or of other pathologic condition. Contrasted with these animals those rats receiving the diets used by the other tribes had high mortality rates, evidence of much disease, and at autopsy showed signs of degenerative diseases of great variety, including most conditions to which human flesh is heir. In each group, the preponderant pathologic alterations or diseases noted were those which characterized the tribe receiving the corresponding diet.

Another extensive study which suggests the relation between the dietary and physical fitness has been reported by Orr and Gilks. They studied the health and physique of two African tribes living under closely similar environmental conditions, but with markedly different food habits. One group subsisted largely on meat, milk and raw blood; the other on cereals, supplemented with roots and fruits. Members of the first group were by far the larger in stature, the stronger, and the heavier. Diseases observed with greatest frequency were rheumatoid arthritis and intestinal stasis in the meat-eating group, and bony deformities, dental caries, anemia, various pulmonary conditions and tropical ulcer in the cereal-eating tribe.

In spite of the apparent complexity of meeting dietary needs, it is not difficult to devise menus which will supply all the known essentials of diet. In establishing any such régime, the requirements of the child should be used as a guide; those of the adult are less exacting. Provision should be made first to include foods which will supply dietary factors most frequently lacking and to build the diet around such foods. Thus, a quart of milk daily will insure against inadequacy of calcium, phosphorus, or of vitamin G. It also will meet the total protein requirement of the small child, and as much as a third of that of the older child. Supplementing this with one or two eggs, and possibly a serving of meat, will provide for any additional protein need, together with valuable amounts of iron and of vitamin A. Adequate amounts of fruits and vegetables will add to the supply of necessary minerals, and supplement the requirements of vitamins B and C. To insure an adequacy of vitamins A and D, it is wise if not essential to include cod liver oil in the daily food allowance. Butter may be of value in this respect, but usually it alone is not adequate for the purpose. The dietary prescribed in our institution and which has been adopted as a standard in several clinics, specifies the use of the following foods daily: one quart of milk, one or two eggs, two liberal servings of succulent vegetables and of fruits, including four ounces of orange or tomato juice or its equivalent, one or two ounces of butter, and one teaspoonful of cod liver oil. Additional foods are to be taken if desired and needed to supplement the energy requirement. No special restrictions are made against any type of food, providing it is readily digestible and not overseasoned. We have seen no evidence that

starchy or sweet foods exert any harmful effect in themselves on the teeth; frequently they tend to crowd out some of the prescribed foods, and in that manner make the diet incomplete. While a reasonable amount of roughage is desirable in the diet, it has not seemed especially advantageous in dealing with caries to stress this phase; in fact, one group of children showing typical arrest of caries while under management received sieved diets, with low cellulose content. Since this work first was reported, various pharmaceutical preparations and proprietary foods have been marketed under claims of particular virtue in preventing or arresting caries. Although we have not attempted to establish or discount such claims, it has not been necessary to use any such product. It should be emphasized that diets adequate in all known essential factors can be formulated from readily available foodstuffs, including cod liver oil and iodized salt in that designation, without the employment of accessory medication. This is in accord with the published results of various other students of this problem. In applying diet therapy to the correction of dental caries, the objective should not be merely to alter the diet sufficiently to arrest caries; it should be directed at correcting the inadequacy of diet in all respects. When this is accomplished, it will manifest itself not only in the improved condition of the teeth, but in the improvement in the general health and the degree of vigor as well.

IS DENTAL CARIES A DISEASE OF CHILDHOOD?*

THADDEUS P. HYATT, D.D.S., F.A.C.D., NEW YORK, N. Y.

"The light of Allah's truth will often penetrate much easier an empty head, than one that is so crammed with learning that many a silver ray is crowded out for want of space."

ANY statement will finally be accepted as a scientific dogma if it is made with sufficient frequency and our clinical experiences seem to support it. We find this to be the status of the statement that dental caries is a disease of childhood. This idea has been proclaimed so often and for so many years by the leading men in both the dental and the medical professions, that to question its truth or to doubt it is almost heresy.

But is this really true? It reminds me of the common acceptance many years ago that all children had to have measles. I was one of five children and can remember when one of us had measles the doctor recommended exposing the others so that all could have it together and get it over with . . . and this was done. Today we protect the child and make every effort to safeguard him from any illness. And so I repeat, is the statement that dental caries is a disease of childhood really true?

To answer this question comprehensively, broadly and reasonably, we should first view the impression or the reaction created in our mind when we hear this statement made. Does not the first impression create the belief that dental caries in children is a normal thing, that it is just as natural a phenomenon as growing hair or any other natural act of nature? If this is true, then why worry or put ourselves out by trying to change this condition? Is this not the logical reaction? We may not be conscious of this in just so many words, but will this not help to explain why so many dentists tell parents not to worry about their child, it is quite all right, dental caries is a disease of childhood?

Let us examine the basis for this mental reaction and this belief.

Parents only take their children to the dentist when they see decay or when the child is in pain or has a swollen face or a broken tooth. Can we expect parents to take their children to the dentist so that he may prevent dental caries by operating on noncarious teeth? Have we taught the public that this is possible? Have we taught this operative preventive possibility in our colleges? Then how can we expect the general practitioner to put this practice into daily use?

We have sufficient data to show that certain factors are always present, and in fact, are necessarily present, before the teeth decay. Does any one ques-

*Read before the Bridgeport, Conn., Dental Society.

tion that two of the factors are food débris and bacteria, and the third factor is that this food débris and bacteria must be retained and be undisturbed for a definite time before decay can start?

It is important at this point to understand clearly the difference between a decalcified cavity and a carious cavity. It is possible to have a decalcified cavity with no decay. Such decalcified cavities are erosion cavities. A carious cavity is the result of food fermentation produced by the presence of bacteria. We find, therefore, that at least three factors are necessary for dental caries. First, bacteria; second, food débris; third, lodgment places where bacteria and food débris can remain undisturbed for a sufficient time to enable fermentation to take place, and thus produce an acid of sufficient strength to break down the organic substance of the tooth. When this takes place we have dental caries.

If this is scientifically correct and logical, then its opposite must also be correct and logical, namely, when we have, first, no bacteria; second, no food débris; third, no lodgment places for the undisturbed and the undisturbable retention of bacteria and food débris, then we have no dental caries.

In view of these facts, would it not be better to say that dental caries is a liability of the tooth rather than a disease of childhood? Will not our reaction be somewhat different? A liability can be prevented. Once we know that it is possible to reduce this liability by operative means, and when parents learn that we can largely prevent decay commencing in children's teeth, they will then bring their children to the dentist before decay starts.

Why is liability to caries greater in childhood than in adult life? After a tooth erupts, no further change takes place in its shape or form. The structure will grow harder and more dense as the years go by, but this hardness or density of the tooth is only related with the slowness or the rapidity of the progress of decay, it is not related with the liability to decay. If the newly erupted tooth has points of liability, the rapidity or slowness of the progress of decay will be largely determined by the quality or condition of the structure.

Many teeth erupt with holes in the developmental lines where two or more lobes come together. As in a brick wall, the joints between the bricks are the weakest parts of the wall, so the weakest parts of the tooth are between the lobes. These openings between the lobes are called pits or fissures. Because of the frequent misunderstanding of dental anatomic terms I find it necessary at this point to call your attention to the fact that pits, fissures and grooves are terms applied to entirely different anatomic formations. Pits and fissures are not grooves, neither are they sulci or fossae. These pit and fissure openings are harbors or lodging places for bacteria, and once they enter, no mouth toilet can remove them. Dr. G. V. Black calls our attention to the fact that teeth having pits and fissures generally show decay two years after their eruption and warns us to be on the lookout for carious cavities in first permanent molars when a child is eight years of age and in second permanent molars when he is fourteen years of age. Dr. Black also calls attention to the fact that in the preparation of pit and fissure cavities for fillings no extension for prevention is needed, because mastication keeps clean the surface surrounding a pit. I have always regretted that Dr. Black did not advocate filling these

pits and fissures at once instead of waiting two years. This, I am sure he would have done, had he lived to see the data which have been secured in recent years and the fact that we now know that 8,400,000,000 bacteria can lodge in these places and cannot be removed by child or adult. His faith, and unfortunately that of many other men, that a large number of pits and fissures will never decay, has not been supported by careful examinations, made in over 50,000 cases.

Inasmuch as the progress of decay is more rapid in newly erupted teeth, and inasmuch as from 75 per cent to 85 per cent of the first permanent molars come into the mouth with pre-carious pits and fissures, is it not more logical and more probable that such teeth will show signs of caries soon after eruption? And is it surprising that this should happen during childhood?

There is practically a continuous period of erupting teeth during childhood life up to the twelfth year. If during this period, any of these teeth have imperfections in their formation which constitute a liability to decay, then naturally there will be greater manifestations of dental caries during this period. On the other hand, if the period of erupting teeth should happen to be between the ages of thirty and forty years and these teeth had the same formative liability, then we would have greater manifestations of dental caries at this time. But in both cases the cause for these caries manifestations is not the age, but rather the fact that the teeth had formative liability. In both periods, had operative preventive measures been taken, and the liability removed, we would not have the manifestations of caries, and therefore we would not call dental caries a disease of childhood or of adult life.

If we make these little holes no holes at the age of six, we shall not find decay at these points at the age of eight. Dental caries is therefore more a *liability* of the *tooth*, rather than a natural disease of a certain age. When the liability of these holes is removed, by closing them, and the billions of bacteria are kept out and mouth hygiene is practiced, we will not find dental caries taking place in childhood's happy days.

The purpose of these illustrations is not to quibble about the terms, childhood's diseases or adult diseases, but rather to emphasize the importance of our knowing, realizing and understanding the opportunity we have to render a valuable health service, and that our professional responsibility is to reduce at once this liability, particularly when it is so simple and practical.

May I call your attention to the fact that there is no such thing as immunity of the teeth to decay. All teeth are susceptible. To apply the term "immunity" to the teeth is both misleading and confusing. The inorganic material of the tooth will always react or break down in the presence of certain acids of sufficient strength. So all teeth are susceptible. That one part of the tooth will break down more readily than another part is simply a question of greater or less liability of that part being exposed to certain acids.

It is interesting to know that though there is a marked difference between mottled teeth and normal teeth, the formative liability of both is the same. We recognize a difference between the terms "structure" and "formative." When the term "structure" is used in connection with inorganic matter, it refers to the hardness, compactness, looseness, density, softness, etc. Formation, on

the other hand, refers to the shape or form. With this understanding of the meanings of these terms when applied to teeth, we are enabled to distinguish what constitutes the difference between mottled teeth and normal teeth. The formation or shape of the tooth in both cases is the same. The structure is different. Even though the structure is different, this does not increase nor is it related to the liability to decay. When decay occurs in mottled teeth, it starts at identically the same point as it does in normal teeth, and these places have identically the same shape or form in both mottled and normal teeth. When the structure surrounding the point of liability is hard and dense, the beginning and the progress of decay are slower. When the structure surrounding the point of liability is soft and less dense, then the beginning and the progress of decay are more rapid.

In a paper presented by Dr. Noyes in Chicago, August, 1933, he made the following statement, "In general the smaller the opening of the pit the more rapidly the process progresses in the dentine, and the entire crown may be destroyed without any breaking through of the enamel or any extension on the surface." And why is this true? Because the smaller the opening, the less able is the buffer influence of the saliva to penetrate and neutralize the acid at the bottom of the pit.

As the child grows older, these points of liability grow less in number. Why? Because, either the teeth having pits or fissures are lost, or caries having developed, the dentist has filled them. But the boy or girl with no pits or fissures seldom suffers from this so-called childhood's disease.

It is not strange for those who are interested in pit and fissure liability to note without surprise that when perfect sets of teeth are found in adults, with no fillings and no tooth lost, that rarely do they find pits or fissures. These persons have passed through childhood without suffering from dental caries. Therefore dental caries is not a disease of childhood but is largely dependent on the formative liability of the tooth. In conclusion let me add that prophylactic odontotomy is not and never has been offered as the panacea for all dental ills. It is intended to prevent the *inception* of decay in precarious pits and fissures. When limited to its field, it secures in the highest degree the successful protection of the tooth at a given point. Prophylactic odontotomy does, however, *prevent* three factors which are favorable for the production of decay. First, it prevents the accumulation of carbohydrates in an *uncleanable place;* second, it *prevents* the localization of *undisturbable* bacteria at a *definite point;* third, it *prevents* the little hole's remaining a *protective laboratory* for the production of acids which break down the substance of the tooth.

THE ABSCESSED DECIDUOUS TOOTH*

GEORGE P. EVANS, D.D.S., JACKSON, MISS.

THE proper procedure to follow in the care of the abscessed deciduous tooth has been open to much discussion and controversy in the dental profession in the past, and it naturally follows that to discuss this subject forcefully, one must be able to give a clear view of one's method of treatment.

Children's dentistry, as presented to us now, is preventive. Practiced as it should be, children's dentistry takes in conditions that are not confined to the mouth alone but extend to the body as a whole. The dentist who works for children and whose preventive vision is that of teeth alone is still traveling with horse and buggy. If a dentist discounts the other physical measures so necessary for proper growth and health, he is not fulfilling his duty to those entrusted to his care.

If dentistry from a preventive standpoint is to progress in keeping with the forward steps made by medicine in dealing with children, then it becomes our duty as guardians of their health to broaden our vision where infectious conditions of the mouth are found.

Why is the chronic abscessed tooth with or without fistula retained? Is its presence harbored for the purpose of maintaining space alone or for the fact that Johnnie's respect for his favorite, tooth-filling dentist may perhaps be somewhat lowered in the painful event of its extraction? Let's be honest with ourselves and face this problem with the child's health as our main objective, and our practice-building efforts secondary. Have you ever heard of a physician's advising the retention of a diseased tonsil condition because he feared the possibility of losing that particular child as a patient?

If a child presented himself with *no teeth* present and had the misfortune to injure the gum by breaking a pencil point off in the tissue, this injury followed by inflammation, infection, and then exudation of pus, I dare say that there is not a man present who would advocate the retention of this condition but would be quick to advise the removal of the cause, i.e., the pencil point, before this patient could be benefited. The same holds true with the presence of deciduous teeth with abscesses and fistula; they should be removed.

Our next question, no doubt, would be *why*.

We are all aware that in the presence of this particular type of infection we find pus, and according to Todd we can best define pus as a fluid containing much granular débris, numerous more or less disintegrated cells, majority being polymorphonuclear leucocytes, the so-called pus cell. Usually in this type of infection the majority of bacteria present are the streptococci and staphylococci. The streptococcic organism we know to be of the most virulent, and in dealing with focal infection this particular organism is the most dangerous.

*Read before the staff of the Jackson Infirmary, May, 1933; and before the Mississippi State Dental Society, June, 1933.

A focus of infection can best be defined as a circumscribed area of tissue infected with pathogenic microorganisms. A focus of infection may be *primary* or *secondary*. The *primary* foci are usually located in tissues communicating with a mucous or cutaneous surface, soft or bony, and the seat of the most common focal infection is teeth and jaws, tonsils and sinuses.

It has been established of late years, as a result of clinical and laboratory research, that focal infection is a cause for local and general diseases.

At this time I want to bring to your mind the diseases that may arise from harboring this infection in the mouth of a child. Since we, as dentists, are not called upon to diagnose and treat existing systemic conditions caused by this infection, it naturally follows that we are not brought face to face with the consequences often enough to force us to adopt a radical, sane measure of treatment.

I shall mention just a few of the systemic disturbances caused by this infection, listing first those that dentists can recognize and aid in correcting:

1. Bad breath.
2. Headache.
3. Stomatitis.
4. Anorexia (general debility).
5. Temperature elevation.

Then there are those systemic conditions that may be caused from harboring this infection, and I shall name only a few: rheumatism, gastrointestinal disturbances, faulty nervous control, secondary anemia, myositis, neuritis, endocarditis, nephritis, pyelitis, iritis, and skin lesions.

We no doubt agree that if there is a possibility of permanently endangering the child's health with any of the above diseases, at a time when we know that due to tissue and bone growth the absorption and distribution of toxic conditions is greater, we should endeavor to make the loss of teeth secondary to health, deplorable as this loss of teeth may be, and obliterate this focal infection which is a menace to the general health.

In the preparation of this paper I ran across the following quotation from an outstanding pediatrician, and with which I shall close: "The argument often advanced that diseased teeth of the first set require no dentistry because they will soon be replaced by a good second set, is analogous to the reasoning of the dirty housekeeper who relaxes her energy completely in view of a remote moving day."

THE VALUE OF OUR EFFORTS*

G. A. McCarty, D.D.S., Jackson, Miss.

DID you ever stop at the end of a day and ask yourself these questions: What value have my efforts been today? Have they been my best, or have I dismissed patients whom I would be ashamed for my professional brother to see and know that I had done the work?

With these two questions in mind, we shall assume that all of us have at some time dismissed patients in whose mouths we did not put forth our best efforts. From this point we shall discuss how we may improve our efforts to their maximum.

First of all, we must be progressive. In other words, we must study, we must learn, and we must know the results of the latest scientific research in order to improve our efforts and methods. We can never be satisfied with the knowledge of dentistry that we received when we were in school. Science is revealing too many startling truths for us to be satisfied to practice dentistry as it was practiced twenty years ago. All of this knowledge and the results of all scientific research are to be had by each of us—to be passed on to our patients as our part in the efforts to build a stronger nation.

Dentists as a whole overlook golden opportunities for the advancement of dentistry. Every dentist should give unselfish thought in trying to do something constructive to call the attention of the laity to the importance of dentistry. After all, does not our success depend upon how much the public knows of the necessity of preventive dentistry? This being true, should we not strive to educate to that point?

When a patient comes to our offices, it is apparent that he or she is seeking dental attention. We may be greeted with something like this—"Doctor, I have a cavity or hole in my tooth that I want filled." Do we seat the patient, fill the one cavity and dismiss the patient, or do we make a complete mouth examination? I do not mean running over the teeth with a blunt instrument and a mouth mirror. A dentist who makes a mouth examination like this is certainly not putting forth his best efforts.

A complete and thorough mouth examination not only requires a mouth mirror and a good set of small explorers, but also a full mouth x-ray examination. You may say—how are we to do this? Perhaps some patients may not want to put this much money into having their defects corrected. But let me add this. If the proper health talk is given and explanation given of the impossibility of a thorough examination being made without x-ray pictures and the possibility of what might be disclosed that could prove detrimental to his health, such as pyorrhea pockets, overhanging margins of all kinds of fillings, proximal cavities, dead teeth, abscesses, cysts, roots, and numerous other things with their far-reaching results physically—nine patients out of ten would submit to a full mouth x-ray examination.

*Read before the Jackson Dental Society, April 13, 1933.

Always keep your patient's health first in his or your thoughts, and your effort will not be in vain. Think what value your efforts have been if you educate one patient to the necessity of full mouth x-ray examination in preventive dentistry. Think of his friends who will benefit by this education. I have patients in my practice who would not think of a mouth examination being complete without x-ray pictures.

X-ray pictures are not only valuable in adult practice but also indispensable in children's practice. When there is doubt about the depth of a cavity in a child's tooth, x-ray pictures can lead you to light. When there is doubt about the condition of the roots, whether the normal amount of resorption is taking place or an abscess is present, x-ray pictures can tell you. When baby teeth must be extracted, it is evident that there exists some abnormal condition. It may not be in the form of decay. A nutritional disturbance may prevent normal resorption, but when a condition presents itself, x-ray pictures should always be taken.

I have had a case that illustrates the value of an x-ray examination and what might have happened to a fine-looking nine-year-old lad if the mother had been satisfied with an examination without the use of x-ray pictures. This mother had taken her child to three dentists, seeking advice about a deciduous central incisor between a completely erupted permanent central and lateral incisor. All these dentists told her the same thing—that it was perfectly all right, the child might never have a permanent tooth there—just to leave it alone and when he reached the proper age, it could be removed and a bridge placed there. The mother came to me, and I immediately told her that I could tell her nothing without an x-ray examination. She was perfectly willing for the child to submit to any kind of an examination to satisfy her mind about it. The x-ray picture revealed a supernumerary tooth lying horizontally to the permanent tooth. The deciduous and supernumerary teeth were removed and the permanent tooth is now in place. These dentists did not put forth their best efforts.

Too often, we are prone to neglect a thing like that in a child's mouth just because he is a child, and we do not care to use the time and patience it takes to do what is necessary. Of course, it is according to individual taste as to whether you like children's dentistry, but if you do not have the patience and time it takes to do work for children—please for the child's sake refer him to some one who does cater to children. You do not gain anything by telling a mother that it is not necessary to fill a deciduous tooth—the cavity is not large enough to fill yet, or to open an abscess and say it will never do the child any more harm now that the pain is relieved. Mothers are getting away from all those old beliefs. Why? Because they are being educated to the value of preventive dentistry. When we fail to refer a child patient whom we do not care to work for to some other dentist, our efforts are not valuable. No one gains by our knowledge.

We, as a profession, pay too little attention to the health of our patients and too much attention to the mechanical side of dentistry. Do not misunderstand me. The mechanical or operative part is very important, but anything left or placed in a patient's mouth that might prove detrimental to

the patient's health is far from being right, and it is up to us as a group to work for higher standards, and erase these things that mar our profession. "Poor efforts and cheap dentistry." Let us talk health to our patients.

Health education is being taught everywhere—in our schools, in our clubs, to the young, and to the old. We must keep abreast of the times if we expect to raise the value of our efforts. We should be well informed on nutrition, the whys and wherefores, good methods of brushing, and types of brushes best suited to different mouths. With this knowledge to impart, we can be invaluable to our patients.

There are innumerable things to be discussed in this subject, such as work for which we may not get the best of fees; even efforts for which we receive no monetary compensation at all; but I should like to leave this thought:

These are the things I shall not forget
When the day's work is done:
The little kindnesses I may have shown
To any one.
The burdens that I may have helped to bear
Throughout the day,
For comrades walking with me down the way.
Not one regret that I had done too much
Where there was much to do,
But this I know, when the long hours pass
In swift review,
I shall look back and wish that I had done
Oh, so much more,
When I turn in at evening to my door.

OCCLUSAL ABNORMALITIES AND RESULTANT SEQUELAE DUE TO HIGH CARIES INCIDENCE AND EARLY LOSS OF THE FIRST PERMANENT MOLAR*†

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INTRODUCTION

THE retention of the first permanent molars has long been recognized by orthodontists and others as of paramount importance in the development and maintenance of normal occlusion and masticatory function together with maxillary growth and correct facial contour.

Normal occlusion has been defined by Johnson[1] as "a condition of occlusion that is functionally in harmony with the metabolic processes that maintain the supporting and surrounding structures of the teeth in a state of health." Retention in a healthy condition of the first permanent molar is one of the most vital factors in the maintenance of this ideal.

In order to eliminate at least one of the predisposing causes of this early decay and loss of the first permanent molar, the first essential is to maintain the deciduous teeth in good condition, not only to prevent loss of contact of the deciduous teeth and consequent drifting into malrelation of the permanent molars but also to secure a healthy environment into which these teeth may erupt.

Past experience and the present study of some hundreds of cases leave no reasonable doubt that the removal of the first permanent molar is seldom unaccompanied by serious future damage to the entire denture. It is true that the services of a skilled orthodontist could bring about more efficient functioning of the remaining teeth by rearranging normal contacts and so minimize the harm which always results. We may safely assume, however, that only a very small percentage of the children under consideration will ever receive orthodontic aid. It is equally true that much of the malocclusion which comes under the care of the orthodontist would be eliminated if greater efforts were made in the direction of early treatment and permanent preservation of the first molars in a healthy condition.

Judging from the advanced carious state or actual loss of so large a number of these teeth at the age of thirteen years, it is obvious that the critical period so far as the first molars are concerned is that soon after their eruption at the age of six years or thereabouts. Not infrequently the first permanent molar erupts at the age of five years, and this fact leads to confusion in the minds of parents as to its future value in the permanent dentition. It is important therefore that care should be taken to watch for the appearance of this tooth in view of the possibility of its early eruption and of the fact that its morphologic char-

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acteristics are such that it invites the occurrence of pit and fissure cavities almost as soon as eruption has taken place and often before the process is completed. In view of the results obtained in this investigation it is felt that the practice of prophylactic odontotomy as advocated by Hyatt[2] has much to recommend it at least in its application to this most important but extremely vulnerable unit in the dental arch.

As is well known, the first permanent molars owe their importance in part to the fact that they are the first of the permanent teeth to erupt and are approximately six years in advance of the second molars. When the deciduous teeth are lost early, they are often called upon to support the bite for many years until the eruption of the premolars and second molars. The relation to each other of the mandible and maxilla and of all the teeth in both arches is largely dependent upon the relation to each other of the maxillary and mandibular first permanent molars. It is therefore impossible ever to compensate adequately for their early loss.

Pulp involvement and apical disease are the natural sequelae of this high incidence of caries commonly found in the first molars. Consequently this group is believed to be the most prolific of all teeth as a source of focal infection, the forerunner of so many systemic disturbances. It has been pointed out[3] that pulpal exposure occurring in the first permanent molars before the eleventh year will result in a pulpitis of a granulating character by virtue of the open apices and comparative vascularity of the pulp. It is this inoperable condition which later in life is most prone to involve the patient systemically.

The frequency with which this particular condition must have occurred in the group under consideration is evident from a study of this investigation. For this reason at least it is perhaps fortunate that the treatment received by the majority of these patients once pulp involvement had taken place was the radical one of extraction.

This study was undertaken in an effort to determine the actual conditions which obtain among American school children of this age group in relation to the incidence of dental caries in the first permanent molar and more particularly to investigate the relative incidence of loss of this tooth together with the extent of malocclusion which results from such loss, with the object of helping toward a better realization of the importance of maintaining the first permanent molar healthy and intact within the dental arch.

METHOD OF INVESTIGATION

A nutritional experiment which is being conducted at the present time in one of the public schools in Rochester, N. Y., presented an opportunity for the collateral study of the first permanent molar in relation to caries incidence and the immediate effects of its loss upon occlusion.

The group available was a particularly uniform one and might fairly be considered as a representative cross-section of the children in American schools today. Four hundred and thirty-three children of both sexes of an average age of exactly thirteen years and all in the seventh grade, underwent a complete oral examination with mouth mirror and probe, and the mouths were charted. These findings were checked in every case by a complete radiographic survey.

Impressions were then taken and the models made of the mandibular and maxillary arches so that the articulation could be conveniently studied and results tabulated.

CARIES INCIDENCE

Of the 433 cases examined it was found that 162, or 37.4 per cent, had already lost from one to four first permanent molars, the percentage lost among the male and female members of the group being approximately the same. In addition to this number 29 children presented one or more of these teeth for which conservative treatment was entirely out of the question and where immediate extraction was indicated.

Adding these cases it was found that 191, or 44.1 per cent of the total, had lost or must lose at an early date from one to four of their first permanent molars. Needless to say many of the 162 children showing molars already lost had also additional first molars requiring immediate extraction.

Of a total of 1,732 first permanent molars in this group it was found that 351, or 20.2 per cent, were either already lost or were beyond saving. Of the total, 14.4 per cent were already lost. In this connection it is of interest to record that Hyatt estimates that 14 per cent of all first molars were lost. Table I shows the distribution among the various molars concerned.

TABLE I

FIRST PERMANENT MOLARS

	MAXILLARY		MANDIBULAR		TOTAL
	RIGHT	LEFT	RIGHT	LEFT	
Extracted	31	19	99	102	251
Requiring extraction	17	15	31	37	100
Total	48	34	130	139	351

The percentages were distributed as follows:

Right maxillary	11 per cent
Left maxillary	8 per cent
Right mandibular	30 per cent
Left mandibular	32 per cent

This is by no means the whole story. A careful oral examination checked in every case by radiographic study revealed an extraordinarily high caries incidence in the first permanent molar. Table II includes teeth which were (1) carious at time of examination and ranging from pit and fissure cavities to advanced caries, (2) restored by filling following caries or (3) extracted following caries.

TABLE II

	MAXILLARY		MANDIBULAR	
	RIGHT	LEFT	RIGHT	LEFT
No. affected	414	415	420	420
Percentage	95.6	95.8	96.9	96.9

The various surfaces involved by decay including filled surfaces are shown in Table III. For the sake of simplicity the decay in teeth which were found to be broken down to the gum line has been considered as being occlusal in origin and classified accordingly. No surfaces have been counted more than once despite multiple involvement in many cases. These figures take on added significance in view of the fact that extracted teeth have been entirely disregarded. In the percentage column is shown the percentage of individual surfaces involved in relation to the number of individual teeth standing.

TABLE III

	MAXILLARY				MANDIBULAR				TOTAL
	RIGHT	%	LEFT	%	RIGHT	%	LEFT	%	
Occlusal	380	94.5	411	99.2	320	95.8	315	94.3	1,426
Mesial	88	21.8	78	18.8	80	23.9	69	20.6	315
Distal	13	3.2	19	4.6	31	9.2	25	7.4	88
Lingual or palatal	198	49.2	202	48.7	13	3.9	11	3.2	424
Buccal	27	6.7	32	7.7	192	57.4	164	49.1	415
Total all surfaces	706		742		636		584		2,688

Taking the total number of cavities or fillings in all surfaces of the first permanent molars and computing the percentage of each in relation to the total of 2,668, we arrive at the following figures:

Occlusal	54 per cent
Mesial	12 per cent
Lingual or palatal	16 per cent
Distal	3 per cent
Buccal	15 per cent

The much greater frequency of mesial compared with distal surface involvement in the first molar is no doubt due to its contact with the distal surface, often carious, of the deciduous molar and the establishment thereby of an area which is not self-cleansing. This fact would seem to support the chemico-parasitic theory of dental caries. It must be remembered too that the distal surface of the first permanent molar is almost entirely self-cleansing from the date of its eruption at six years until the eruption of the second molar at twelve years.

The 433 patients were divided into groups according to the nationality of the parents. It was found that loss of the first permanent molar occurred as follows: Italians 0.87, Americans 0.81, Northern Europeans 0.78, and American Negroes 0.20, giving an average loss throughout the group of 0.81 per mouth. The proportion of mandibular first molars lost compared with the maxillary first molars was found to be more than three to one.

In considering the figures presented in respect to the teeth extracted and absolutely unsavable, it must be remembered that the caries figure for the remaining first molars is higher than that for any other tooth. Consequently it is obvious, particularly in view of the general neglect encountered throughout a large proportion of the group, that scores of the first molars considered as savable for the purposes of this investigation would remain so only if immediate

conservative treatment were instituted. In view of the past history of neglect a very high percentage of these teeth will ultimately be lost and many within a comparatively short period. In this category we might also reasonably have included those teeth, supporting large restorations or multiple fillings, which will undoubtedly be lost eventually.

MALOCCLUSION FOLLOWING LOSS

With a view to determining the effects upon the occlusion of this frequent early loss of the first permanent molar, a careful study was made of the models of each of the 191 cases so affected.

It is not intended to discuss at length the numerous effects which early extraction of one or more of these teeth has upon mandibular and maxillary growth through loss of the natural stimulus to development, or the establishment of inharmonious relationships between the two jaws with the resultant interference with the normal facial contour. The primary object of this study was to investigate the extent of malocclusion and the immediate loss in masticating area resulting from the effect of loss of this important dental unit upon the adjoining and antagonizing teeth.

In each case (1) the individual teeth which suffered total loss of occlusion and (2) those which suffered varying degrees of loss in function were noted and tabulated. It is not suggested that occlusion in all cases would have been 100 per cent had it not been for the loss of one or more of the first molars, and the figures presented in Table IV refer only to those teeth which have been detrimentally affected by this loss. Where malocclusion of individual teeth has been considered as due to other factors such as general crowding or tardy eruption or the loss of teeth other than the first molar, these have been disregarded. Although in many cases it is obvious that some teeth must be affected later, yet only the conditions met with at the time of examination have been considered and only those teeth already affected included in the tabulation. Only the teeth in the immediate vicinity have been considered, viz., the molars and premolars. Were we to include other teeth affected, the total of teeth whose faulty articulation is traceable to loss of the first molar would be greatly increased. Not infrequently in cases of unilateral extraction there was noticed a general movement of the entire arch so that the median line was shifted laterally toward the mutilated side with the result that the normal occlusion of canines and incisors was materially altered.

Early extraction of the first molars was found to lead to the development of a closed-bite condition through loss of occlusal support during the eruption of the premolars and second molars. Thus the incisal occlusion may again be seriously affected. These and other conditions are so well known that they require no further enumeration. They are referred to here in order to emphasize the fact that teeth other than the premolars and molars or those in the immediate vicinity, are frequently thrown into occlusal disbalance as a direct or indirect result of loss of the first molars. The group most frequently rendered completely functionless is logically the first molars themselves, either directly through extraction or through loss of the antagonizing tooth. Some degree of articulation is often maintained, however, by the forward movement of the erupting

second molar. The greater the movement anteriorly of the opposing second permanent molar and the more complete its articulation with the first molar the greater will be the possibility of complete loss of the masticating surface of the second molar which is held in its normal position by the first. The occlusion of the posterior teeth following extraction of one of the first molars is seldom a satisfactory one on account of the tipping mesially and often mesiolingually of the second molar.

Even if both the opposing first permanent molars are lost on the one or both sides, it does not necessarily follow that the occlusion of these teeth alone is sacrificed, particularly if these extractions have not taken place simultaneously. It is then that mesial tipping of one of the second molars may occur before the antagonizing tooth has had an opportunity to drift into a position to help in maintaining normal articulation. Frequently the end-result is nothing better than a one-point contact. It will be seen from Table IV that the second molars are next to the first molars in order of frequency of complete loss of function at this age.

Although the function of the premolars is comparatively seldom completely lost, yet it is this group whose masticatory efficiency is most often impaired. This is due not so much to their position in the arch as to their anatomic formation. The existence of the anterior and posterior inclined planes renders them peculiarly susceptible to movement in the direction of least resistance under the stress of the force exerted by the muscles and ligaments of mastication once the stabilizing action of the first molar is removed.

TABLE IV

	TOTAL LOSS OF OCCLUSION			PARTIAL LOSS OF OCCLUSION		
	FIRST MOLARS	SECOND MOLARS	PRE-MOLARS	FIRST MOLARS	SECOND MOLARS	PRE-MOLARS
Maxillary						
right	86	40	5	61	56	156
left	77	37	7	45	50	134
Mandibular						
right	139	2	1	11	92	149
left	138	1	1	8	90	141
Total	440	80	14	125	288	580

A condition very commonly encountered in the premolar region under the circumstances is cusp-to-cusp articulation instead of the normal interlocking occlusion of the inclined planes. This phenomenon is often favored by an uneven drift of the maxillary and mandibular premolars but is most frequently met with where the first molar loss is limited to one jaw only. Torsoversion is frequently seen under these conditions, the second premolar being the tooth most often affected. It is not uncommon to find the second premolar in contact with the second molar with the result that the hiatus in the arch is behind the first molar. This may aid in stabilizing the second molar but will leave no antagonizing tooth for the second premolar of the opposite jaw. In some cases malocclusion in the premolar region is due to factors other than the loss of the first permanent molar. It is only where loss of proximal or occlusal contact with the

first molar has been at least a contributory cause of the resultant condition that these teeth have been included among those enumerated in Table IV. It is recognized that normal occlusion is not essential for efficient mastication. Therefore where satisfactory interlocking of the molars and premolars has occurred either in pre- or postnormal occlusion, these teeth have been disregarded in our compilation of teeth detrimentally affected by extraction of the first molar.

From the table compiled conservatively as indicated above, it will be seen that through the loss of 351 first permanent molars by 191 children of an average age of thirteen years, a total of 1,527 teeth already either are wholly lost from the masticatory mechanism or have had their efficiency seriously impaired. It is self-evident that this total will be greatly augmented following the loss of the 100 molars (included in the total of 351) which require immediate extraction. Conditions will become progressively worse as extraction of these broken-down first molars permits freedom of movement of the adjoining and antagonizing teeth. Furthermore, the state of affairs will be infinitely worse after the loss of those teeth which, although savable at the time of examination, will ultimately be extracted as a penalty for neglect.

It is important to remember that the loss of the first permanent molar usually takes place while the mandible and maxilla and their alveolar processes are in the process of development. Allison and Brooks[4] state that "if the lack of use is during the period of growth, there will be permanent changes in the size and shape of the affected bone." Stillman and McCall[5] contend that lack of occlusal stress will result in lowered local resistance. Legg[6] quoted by McMillan[7] states that "bones as well as soft parts waste or increase in size according to their functional activity."

The loss of function of the teeth individually and collectively through loss of the first permanent molar is reflected by conditions other than by impairment of the efficiency of the masticatory mechanism and disharmony in maxillary growth and facial esthetics. The value of function in any part of the human anatomy is generally recognized. In order to maintain normal function in the mouth it is of the utmost importance to maintain an unbroken arch. The interference with normal masticatory function of both the proximal and antagonizing teeth following loss of the first permanent molar by disease and subsequent extraction thus leads to occlusal disbalance or traumatic occlusion. This is usually followed by a pathologic condition of the periodontium or periodontal disease. Traumatic occlusion is defined by Stillman[8] as "nothing more or less than a mechanical disturbance of function." He states it is "an indication of, and is due to, a lack of balance in the occlusal relation of the teeth of the mandible and maxilla." It is obvious from a careful study of the cases in this investigation in which one or more of the first permanent molars have been lost that the loss of this tooth is one of the most frequent causes of lack of symmetry in the dental arch; and the presence of an "injurious occlusal relation" would seem to be always an outstanding feature. The almost universal occurrence of abnormal relationships of the inclined planes of the opposing teeth together with cuspal interference with normal lateral movements would strongly indicate at least a condition of potential traumatic occlusion which Goslee[9] asserts is found almost invariably whenever the dental arch is weakened by the loss of one

or more teeth. The almost general acceptance by periodontists of traumatic occlusion as being the chief local causative factor in periodontal lesions would therefore appear to be an added and important reason for concern over the high incidence of disease and loss of the first permanent molars.

Although evidence of periodontoclasia may not manifest itself until much later in life and although dependent to some extent upon variation in resistance of the tissues and other collateral factors, the condition nevertheless exists in a potential form as soon as occlusal traumatism has become established through this too common break in the integrity of the dental arch and the resultant faulty articulation.

SUMMARY

1. In a uniform group of 433 children of both sexes of an average age of thirteen years careful mouth examination checked by radiographic study revealed the fact that the 162 children, or 37.4 per cent, had already lost from one to four first permanent molars.

2. Of a total of 1,732 first permanent molars it was found that 20.2 per cent either were already lost or were beyond conservative treatment.

3. Additional data relating to caries incidence serve to emphasize the need for early and constant supervision and treatment of these teeth.

4. The importance of this unit in maintaining the integrity of the dental arch and the far-reaching effects of its frequently early loss upon occlusion are indicated from a study of the models in relation to articulation and of the data presented.

5. This loss of function or interference with the normal function of the teeth is reflected by conditions other than by impairment of the efficiency of the masticatory mechanism and disharmony in maxillary growth and facial esthetics. Loss of the first permanent molar is seldom unaccompanied by actual or potential occlusal trauma, and the importance of traumatic occlusion in the establishment of a pathologic condition of the periodontium is now generally recognized.

Thanks are due to Dr. H. J. Sedwick of the Department of Anatomy for assistance in the clinical examination and casting of models.

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PUBLIC DENTAL HEALTH*

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INCREASED efficiency in public dental health service has been occupying the attention of welfare workers the world over for many years. Dentists are not alone in recognizing the great need of the public for surcease from dental ills. Leaders in charities and humanitarian workers have been ambitious in their efforts to establish dental health service for federal, state, and municipal interests.

Americans for America and America for the world must be maintained through a race of people physically fit, mentally alert, and spiritually supreme. The highest degree of citizenship includes a patriotism that aspires to preserve a national vigor which will show to the world that token of excellence which must be naturally expressed in fitness of body, mind, and spirit.

It was President Wilson who said: "The real thing we have to consider in America is the American people, their energy, their elasticity, their originative power, their capacity to hope and to achieve." We are living in an age in which most of the agencies striving to lift humanity out of its unfitness, its insufficiency, its lack of normalcy, and its incapacity are taking into their activities the consideration of dental health as a matter of great concern in the welfare of the individual as a unit of the public good.

Discovery and correction of dental defects are recognized as essentials in humanitarian procedure. Oral health cannot be separated from the general processes which unite to keep the body in order. It is being conceded more and more that a beginning must be made in connection with conditions in the mouth, the doorway of the body, in diagnosing and treating any conditions of ill health. The time was when the mouth had no consideration as a factor in cause and cure of disease. It was an unacknowledged part of the human anatomy in connection with sickness and physical discrepancies. Groping blindly in the dark, indifferent to the real importance of oral manifestations, man worked with impunity on the teeth of his fellow men, little dreaming of the sacred ground upon which he was treading. But the law of progress led the honest worker to the edge of the desert of human hopes and fears where the bush of knowledge was illuminated with the fire of righteous endeavor. The voice of intelligence bade man to enter into his full privilege of useful service to his fellows and no longer yield to the handicap of the unacknowledged place which the mouth occupies in bringing good to man through all the body. With this awakening the mouth received its rightful place as an essential part of the human system. The world is beginning to know that the oral surgeon deals with conditions which have myriad avenues of associations reaching to and influencing the whole economy of man.

*Read before the Missouri State Dental Association.

To see and appreciate the importance of dental health is a great advanced step in modern health service. Public opinion is gradually seeing the light and recognizing the power dental hygiene can contribute to raise the standard of physical fitness. Perfection is the natural state of man. Health is his normal heritage. Health is universal. There is far more health in the world than ill health. Healthy people are in the majority everywhere, yet we are conscious of the large activity being expended to care for the sick, the suffering, the physically deficient, and the mentally abnormal. Dentistry is doing its full part in this service, and the public is richer because of the discoveries which dental forces are developing for the comfort and benefit of the race. Dentistry is having a part in bringing to pass the truth of the old adage:

"Laugh and the world laughs with you,
Weep and you weep alone."

Through its alleviation of pain, suffering, deformity and other physical discrepancies, it is bringing a normal state to thousands who otherwise would never be free because their troubles had their origin in mouth causes which needed oral recognition and treatment before a cure was possible.

PROGRESS

We are approaching the threshold of a millennium when dentistry will have discovered itself, will have found its highest good; when it will have assumed its rightful place among man's blessings in administering a service it has not yet dreamed of, a service not of fear and pain, elimination and restoration, manufacture and repair, but a service of conservation of natural resources, discovering, developing and maintaining oral perfection. In this millennium the public as well as the dentist will be dentally intelligent. The question of the relation of sound teeth and a clean mouth to a normal body is a matter of public concern, and the public must be educated in this direction. Prevention rather than repair is the keynote to the situation. Prevention must be the inspiration for the welfare of the individual. Once this becomes an illuminator of public conscience, the importance of oral perfection will lead the way to definite habits of oral thought-taking that will establish a cure for present-day dental ills. The highest progress in dentistry will begin when out of the laboratory of mental research men, women, and children are taught to think right about their mouths and teeth, with a resultant activity that will give oral cleanliness its proper place among man's considerations for his physical betterment.

AWAKENING

Believing that an awakening of the public conscience was necessary to an appreciation of the benefits of dental health two Peoria dentists, about twenty-five years ago, began to create a nucleus for endeavor that aroused the enthusiasm of their fellow dentists in Peoria. This enthusiasm spread rapidly. It was encouraged by the Child Welfare League. The Public Health Nursing Association and other local interests united to develop in a work that became established on a firm foundation and has been doing volumes of service through its dental activities in the community.

HONOR TO WHOM HONOR IS DUE

I have reviewed the history of this work several times, and it has appeared in print. Its presentation has been the inspiration which has founded many similar activities in various parts of the country. I have a deep appreciation for the efforts of these men and the agencies which cooperated with them through all the formative period that was necessary in pioneering to bring to pass what is functioning so splendidly today for the good of the community. I pause to give again grateful acknowledgment to these workers for their unselfish efforts, their careful oversight and stimulating encouragement of the work during all these years. Their sacrifice of time and effort, their dauntless courage in the face of discouragement; and their persistent effort, tempered with kindliness and wisdom, has resulted in a public health benefit to citizenship that is wholesome and enduring. Passing over all these years of hard work and faithful devotion, this paper will deal with the movement in its present-day status.

DENTAL HYGIENE IN THE SCHOOLS

The interests of public dental health in Peoria are focalized in a system of dental hygiene in the public schools. The work has a threefold aspect: inspection, dispensary service, and education. The educational side of the program is described in another paper. This paper will deal with the inspection and dispensary service.

INSPECTION

Up to the present time, dental inspection has been carried on with the pupils in the first four grades. An inspection card has been developed which is taken to the school several days in advance of the examining day. The cards are arranged in bundles of ten for the purpose of aiding the principal in distributing them to the teachers. The plan is explained to the principal and a letter left with him for reference. Letters are also left with him to give to the teachers so that they may have the plan before them. The plan calls for the teacher to fill in all the blanks on the cards and have them ready for the day of examination. Name, address, school, grade, room, age, and date of examination are the items asked for. The teacher is also asked to check an item on the card called "unable to pay," for the teacher and principal know the pupil's home conditions better than any one else.

On the day of examination the dentist and his assistant have established themselves before a well-lighted window most convenient to all rooms. Both dentist and assistant are dressed professionally. There is a small table on which the assistant may write and take care of the cards. Beside the table in front of the window a chair is placed for the pupils to sit in while being examined. On another chair are placed a basin of water and soap, with plenty of towels to be used as occasion demands. There are two glasses containing a strong antiseptic solution. In one of these a dozen mirrors are placed, also some explorers and cotton pliers. A dentoform container is also at hand with some cotton in it.

Inspection is conducted room by room, beginning with the lowest grade, each teacher coming with her pupils to maintain order. Each child has his own card which he hands to the assistant, who marks down the findings called by the examiner. Every tooth with a defect is checked and a cross marked for the teeth recommended for extraction. Condition of the teeth is marked as good, fair, or dirty. The card is arranged to take account of retarded dentition, orthodontia needed, infected gums, able and unable to pay, notice to parent, under care of own dentist, under care of school dentist, and those needing no present attention.

After all the children are examined, the assistant sorts the cards according to class of defects, totals the findings, and prepares a report for our records, for the principal, and for the superintendent of schools. Each child having defects receives an envelope with a notice to the parent in it, also a folder of instruction for the parent. The pupils who are unable to pay for service receive a different notice from those who are able, and with it an application card for free service in the school dispensaries, which must be signed by the parents and returned through the teacher to the principal. The school dentist calls in a week or ten days to collect the returned cards. The examination cards are delivered to the dispensary nearest the school examined. The notices sent home to parents call attention to cleaning needed, to defects, and to necessary extractions. The pupils who have good teeth also receive an envelope containing a folder of instruction to parents.

When the envelopes containing the notices are ready to be sent to the homes, they are given to the teacher with the following letter:

To the Teachers:

When you give these envelopes to the pupils, instruct them to take them home and urge their parents to read all that is inside of the envelopes.

The yellow slips bear the names of the pupils who need dental service but are unable to pay for it. Their envelopes are grouped separately with a rubber band around them so that you may distinguish them from the rest. We suggest that you deal with these envelopes separately explaining to the pupils that their envelopes contain a special opportunity for free dental service in the school dispensaries.

If the parents want the school dentist to do the work for their children free of charge, they will need to sign the application card enclosed, and return it. We must have the parents' signature on the application card.

It is our opinion that it would be more considerate to bring this matter to the pupils' attention privately, so as not to embarrass them before those who are able to pay.

A sample notice is attached to this letter. See that both sides of the application card are properly filled out and returned.

Please follow up these application cards and reasonably urge their immediate return.

The service is not compulsory, but the pupils should be made to feel that it is a great opportunity.

Hand the returned cards to your principal. I shall return in about a week to collect them. Thank you for your cooperation and its follow-up.

(Signed) ----------

Supervisor of Dental Health.

Simple as this procedure seems to be, it calls for organization and executive ability. A cheerful dignity must prevail, and the entire trend of the examination must be educational to the pupil. Close application to detail and

carefulness in procedure are essential to the success of the examination. The psychologic effect of the occasion must be taken into account and the entire atmosphere guarded lest the child gather wrong impressions which he might take home to the parent. Absolute cleanliness is essential as well as freedom from remarks of any kind that might arouse fear or mystery in the child mind and thus lead to a wrong interpretation. The pupil must see that you use a clean mirror in his mouth and those in line must also see that you do so.

It is our opinion that no child should be forced to an examination. When we began our inspection in the Peoria schools, there were many objectors. We were cheerful about it but never forced the issue, always sending home with the child the folder of instruction to parents without any further notice. This year in over six thousand examinations we have not had a half dozen objectors. The follow-up of these examinations is no small matter and calls for many visits to the schools to collect application cards for free dental service. Ignorance and indifference on the part of parents make many complications.

After the cards are collected, they are taken to the dispensary where appointments are made as fast as possible. The principals and teachers are responsible for the pupils' attendance at the dispensary.

KINDERGARTEN

This year in addition to the regular inspection in the first four grades the kindergarten pupils have been included. The findings in the mouths of five-year-olds have been appalling. Some mouths had every tooth defective. Many were in need of orthodontic service. Many abscessed teeth were in evidence. Many extractions were needed. Only about 45 per cent of the pupils had good teeth, while about 10 per cent were under the care of their own dentists and had some very good service in evidence. Among them were a number under orthodontic treatment.

As a result of this examination we are more than ever convinced that public school dental service should begin with the preschool child. If we can begin with the child at this age and carefully follow up through the grades, there will be little to do after the fourth grade, and even in this grade the service will be principally the elimination of deciduous teeth after they have served their usefulness.

EIGHTH GRADE

In contrast to this kindergarten examination this year we examined the pupils of the eighth grade. This was done in order to cooperate with the director of physical education in his five-point program of physical excellence which called for a perfect mouth condition if they were to qualify for a merit pupil diploma. As a result of this examination there was a large percentage of corrections from notices sent home to parents. The signatures of dentists after the defects had been corrected showed a distribution of service among the local dentists that was very pleasing to note. This examination was a great source of satisfaction because it proved the progress that had been made in our school dental program. We found a little more than 80 per cent of the eighth grade pupils with mouths in good condition. Of the remaining 20 per

cent very few were in an extreme condition. Those who were badly in need of attention were pupils who had come into the system after they were in the fifth grade. All others had either perfect mouths or were under the care of their own dentists. This proves the effect of dental education in the schools.

DISPENSARY SERVICE

Dispensary service is confined to those unable to pay in the kindergartens and first four grades. No major operations are performed, prevention rather than repair being the keynote of the operative service. Only the simpler deciduous extractions are accomplished. The more difficult ones, which call for anesthesia, and all permanent extractions are referred for service to the dentist of the family's choice on their own responsibility. No root canal treatments are made with a view to root fillings. Very few permanent fillings are inserted. Ames' oxyphosphate of copper cement is used for fissure treatment in first permanent molars and for temporary fillings in deciduous teeth. Carbol-eugenol is also used as a filling material and serves a very useful end in difficult first permanent molar situations as well as in deciduous teeth. Common cement fillings are also inserted. No gold or porcelain operations are provided for in the rules and regulations adopted by the school board for the conduct of the department.

It is our opinion that the public school dental clinic is not the main part of the dental hygiene activities in a public school system. Incidentally there must be the clinic feature to provide for the comfort of the indigent pupils in order that they may be able to grasp the full import of their teaching, so far as comfort and freedom from mouth consciousness will enable them to. We do not believe, however, that it should be expected of a school board to bear the responsibility of carrying on a dental practice even among the indigent. Only the simplest service should be rendered to serve to an educational end. An abundance of reparative and remedial service can be carried on only at the expense of preventive service. So long as repair and the correction of extreme defective conditions are made the main object of the dispensary school service, the preventive program is sure to suffer. While it breaks the heart of the operator to pass on the responsibility of the extreme conditions found so often in the mouths of school children to the parents, yet it seems too bad to take up the time of the dispensary working hours with these extreme conditions when the same time could be used to a larger advantage in preventing a multiplicity of these same conditions. It is too bad that in our situation there is not a welfare clinic where these cases might be referred for treatment at either city or county expense. We do not have such a means of cooperation, but I cannot see that it is the business of the school board to finance anything but an educational program, and with it such dispensary activities as shall render the indigent or unfortunate comfortable so that they may receive the instruction which they are not capable of receiving when they are suffering. This suffering can be relieved in large measure through a preventive program. The permanent restoration should be provided through some other community effort. While the dispensary service can be made to reach a few, the inspec-

tion and education can be made to serve the entire system in the grades and thus bring benefit each year to all.

After several years of effort in regard to orthodontic procedure for the indigent in connection with school dispensary service it seemed to us that orthodontic procedure is contraindicated in the school dental dispensaries. In connection with a recent case which was brought to our attention, and for which we were importuned to secure free service, the following opinion was rendered by an orthodontist who has taken care of several hundred cases in our schools free of charge during the last twenty years.

Dear Doctor Smith:

As I am going out of town this week and shall not have an opportunity to see you personally, I am writing to you in regard to the case of E. L., the little girl from the L------ School you brought to my attention last Friday. On further consideration of the child's case, I will say that the malocclusion is somewhat complicated when viewed from the standpoint of orthodontic treatment.

First, there appears to be some obstruction to the nasal respiration.

Second, if the child could be observed when preoccupied, I believe a habit of the tongue or lips would be discovered that has some bearing upon the malformation of the dental arches.

Third, either from habit or from impaired function of the teeth due to defective occlusion of the deciduous molars, the growth in the width of the arches has been retarded.

Fourth, the open-bite appearance will no doubt improve with further eruption of the maxillary and mandibular incisor teeth.

From the limited examination made, the treatment indicated at this time would be a general expansion of both maxillary and mandibular arches which could be most conveniently managed with lingual spring metal wires (gold and platinum), round vertical pin tubing, and guard wire. Using base metal bands, the net cost of such an appliance would be approximately $13. If precious metal bands were used for the anchorage, the net cost would be approximately $20.

From the appearance of the child, it would be best to adjust such an appliance once every two weeks. If the patient has good home supervision and would keep the teeth clean, the visits for adjustment of the appliance might be arranged once every four weeks.

The expansion of the dental arches, as outlined, might be completed in four months, and would be about all that could be accomplished in the treatment of the case until the time of the eruption of the permanent canine and the premolar teeth. There is much in the general appearance of the child that clouds the future of the case and the final result of treatment.

As you know, I have spent a great deal of time and effort in the treatment of public health cases. The greatest obstacle I have found has been to retain the cooperation of the patient and parents through a long period of treatment. Where they have no financial investment in the treatment of the case, the burden more often falls heavier upon the operator than in those cases where the parents have an investment in the treatment to the extent of having a financial interest at stake.

For the sake of these children, I wish there were some way the treatment of malocclusion for the indigent child could be accomplished in connection with your dental activities in the public schools if the cost of such work was not prohibitive.

Sincerely yours,

(Signed) R. C. WILLETT.

It will be seen readily from this expert opinion how impossible it would be to take care of such cases as this in a school dispensary. This is only one of many that come to our notice and the net cost involved is prohibitive. It could not be expected of a board of education to finance procedures of this type. In addition to this it must be borne in mind that school is not in session during

the summer months. It will also be seen how unreasonable it would be to expect so much free service from local dentists, also that dentists rendering such service should be allowed to pick their cases from a standpoint of environment, cooperation, and general merits involved. In this particular circumstance home conditions and the general history secured were not conducive to a successful carrying out of the operative technic necessary.

Numerous cases for the worthy poor are still cared for free of charge each year, but this is all done outside the school dispensary and only where home conditions and circumstances are conducive to cooperation and appreciation. Orthodontic procedure cannot be undertaken for the transient or uncooperative. A certain degree of appreciation must be in evidence for the success of the work. The time involved, the class served, the transient aspect of the case, all these have to be taken into account. In work of this character no operator could afford to be less than thorough no matter how generous he was with his time. With this in view the conscientious operator would be very careful in selecting only such cases as would lead to desirable termination.

There are many pitfalls to be avoided in school dispensary service. The neophyte, unacquainted with this particular phase of public dental health, is liable to let his sympathy run away with the development of a better judgment. Appalled by the extreme call for reparative conditions the tendency is to spend all the time in reparative procedure, neglecting the preventive service which is the more important side of public school dental dispensary activity. It is hard to say *no* in one's mind, to the pitiable conditions that present themselves for skillful dental service; hence repair and remedy are liable to take up all of one's time and energy. Prevention neglected goes by default, and the same old reparative conditions prevail. I consider the fissure procedure in first permanent molars of many children far more important than time spent on extreme repair and remedial conditions for a few. Many first permanent molar fissures can be cared for in the time involved in the treatment and care of a few teeth calling for restorative measures.

A very great man once said that we should not cast pearls before swine. The wisdom of his doctrine is made apparent in considering many of the problems in connection with a public school dental dispensary service. While we always must be merciful, kind, generous, unselfish, and just, we must at the same time be efficient, and our degree of efficiency in a school dental program must be governed by a conscience that seeks to serve the greatest number with a view to accomplishing the greatest measure of good.

RULES AND REGULATIONS

Our school dental hygiene program is governed by a set of rules and regulations adopted by the Board of Education. These rules were written as a result of years of experience with many problems under many circumstances, regarding many affairs and things. There have been many pitfalls and political situations to embarrass the progress of the work, but loyal support in the community has always come to the rescue to save the day. The end has always been a clarifying of the situation to show that it was not a malicious spirit

at work but a lack of understanding regarding the value and function of the department. These usually disappeared when information was given. One of the embarrassing situations is the frequent changes which occur on the Board of Education as the result of each year's school election. There are now only two members of the school board who were on the board when I took charge of the work twelve years ago. This has called for a salesmanship annually which has required diplomacy and help from many angles. The Board of Education has always arisen to the occasion in support of the dental department. When its members have been informed as to the issue in question, they have shown their confidence in the department by the hearty support they have given to its problems. Our superintendent of schools has been very enthusiastic regarding the dental health activities and his counsel and advice have been in keeping with his confidence in the educational value of the department.

CONCLUSION

The public school is the great avenue through which the benefits of dental health are to reach the people. Concentration of effort is essential that organization and system be developed so that every school child and every child of preschool age be given a dental health examination at least once a year. In addition to this an adequate follow-up system should be devised so that operative service may be urged where it is needed.

Conscientious consideration of preventive dentistry in child life will bring the reward of service well directed and will help to mold the future of a generation that will be more physically fit, mentally alert and visually perfect.

ABSTRACTS OF
CURRENT LITERATURE

NUTRITION AND PEDIATRICS

By Samuel Adams Cohen, M.D., New York City

It is the purpose of this Journal to review so far as possible the most important literature as it appears in English and foreign periodicals and to present it in abstract form. Authors are requested to send abstracts or reprints of their papers to the publishers.

Significance of the Water Metabolism in Health and Disease. Irvine McQuarrie. J. Pediat. **3**: 539, 1933.

McQuarrie aptly remarks that the appreciation of the true significance of water in body economy is only now beginning to manifest itself. He states that without water there can be no life and in a mammal such as the dog or man death may occur if it or he is deprived of water for longer than a few days, or where there is a loss of little more than one-fifth of the water incorporated in the tissues.

On the other hand homeostasis or constancy of the body processes and materials is synonymous with health—and all evidence indicates that water is the most important single agent in making such constancy possible. The newer chemistry of water H_2O reveals that its peculiar physical properties can be explained only on the basis on its being a mixture of molecules of different sizes and degree of activity with spacial arrangements very different from those originally attributed to it.

Continuing, this authority quotes Matthew, who pointed out that "the younger, the more vigorous, the more alive, the more actively growing, the more impressionable cells are, the more watery they are." In analyzing the water content during the growth and development of man the aforementioned quotation of Matthew is greatly substantiated. At the sixth week of life the human embryo is 99.7 per cent water; at birth the percentage of water has decreased to between 71 and 72, and during adulthood, when growing has ceased, the body contains from 58 to 65 per cent water.

Normally the source of water in the body arises from: (1) water taken by mouth; (2) water which is contained in food; (3) water resulting from oxidization in the tissues; and (4) water arising as a result of chemical processes concomitant with tissue metabolism. Disposition of water in the body is via five routes: (1) urinary loss, (2) fecal loss, (3) insensible from skin and lungs, (4) loss in sweat secretions, and (5) deposited with new tissues. Under ordinary conditions McQuarrie states that two-thirds of the water loss from the body is by way of the kidneys.

This authority, who writes from the Department of Pediatrics, University of Minnesota, Minneapolis, points out that the water requirements of indi-

viduals vary with such factors as age, muscular activity, temperature and humidity of the environment, type of diet, and also with the functional state of the various organ systems. He states that the water requirement of the body in terms of age and size roughly parallels the total energy metabolism. Accordingly the water requirements are several times greater per unit of body weight during infancy than during adult life.

Specifically speaking, the range of the average daily water requirements is from 4 to 5 ounces per pound of body weight for a baby ten days old (weighing 7 pounds); from about 4 to 4½ ounces per pound of body weight for a one-year-old baby (weighing 21 pounds); from 3 to 3⅓ ounces of water per pound body weight for a six-year-old child (weighing 44 pounds); and from 1⅔ to 2 ounces of water per pound of body weight for a fourteen-year-old child (weighing 100 pounds). It may be interesting to note also that in adult man the average daily amount of secretion of digestive fluids approximates about 8,000 c.c. or 8 quarts of fluid daily, which is divided as follows: about 3 pints daily for secretion of saliva, 2 to 3 quarts daily for secretion of gastric juice and approximately 4 quarts for the total twenty-four-hour amount of fluids contained in the bile, pancreatic juice and succus intericus.

McQuarrie points out that thirst, which is apparently a sensation depending in some degree upon the deficit in the free water of the salivary glands and mucous membrane of the mouth, is usually a trustworthy indicator of the body's need for water. Moreover, he states that the body has more or less of an automatic mechanism for maintaining an optimum content of tissue water, and in a large measure this mechanism is the answer to the question which is frequently asked as to the possibility of an individual partaking of too much water. In this respect McQuarrie states that the "extra water taken, if unaccompanied by sodium chloride in or near isotonic concentration, is fairly promptly excreted by the kidneys with but little effect upon the general body metabolism." Clinically speaking, this statement is in accord with practical experiences except, of course, in some individuals who have certain pathologic conditions of the body.

This authority states that the dietary has little influence on water regulation, but his statement is qualified by three conditions: first, that a minimum amount of water is required by the body for the excretion of nonvolatile end products of catabolism; second, that prolonged protein deficiency causes water retention; and third, that ketogenesis promotes loss of body water.

The most important extrinsic factors are the interrelated endocrine and nervous influences. In the human being, more particularly in certain diseases, and in animal experimentation the secretion of the posterior lobe and pars intermedia of pituitary body has a definite antidiuretic action. That pituitrin affects other tissues as well as the kidneys is indicated by the finding that the salivary, gastric and intestinal secretions are inhibited by the injection of pituitrin.

In regard to the influence of other endocrines on the excretion of water, this authority quotes from the investigation of E. Z. Epstein and others who have shown that the diuretic effects of thyroxin (thyroid hormone) are due not to any direct action on the kidney but to its mobilizing the fluids from the

tissues of the body into the blood. Whether or not an endocrine factor is involved in the water retention associated with obesity is not definitely known. It is well to mention, however, that chronic water-logging of the tissues apparently lowers the resistance to acute infection.

Immunization With Bacillus Pertussis Vaccine. Louis W. Sauer. J. A. M. A. **101**: 19, 1933.

In a well-controlled series of cases which were followed for at least five years Sauer of the Evanston Hospital, Evanston, Illinois, reports excellent results in the prevention of whooping cough in children who have been exposed to this disease but who have been previously injected with *Bacillus pertussis*. Sauer is to be congratulated on this outstanding success in the field of preventive medicine, particularly in view of the discouraging and more or less unsuccessful results previously reported by many others with the use of pertussis vaccine to prevent whooping cough. From data on hand Sauer is of the opinion that the pertussis vaccine is not a curative agent for whooping cough but like *B. typhosus* vaccine and *B. diphtheria* toxoid it will actively immunize susceptible persons.

Bacillus pertussis vaccine which is used by the author is prepared from recently isolated hemolytic strains, grown on Bordet medium made with freshly defibrinated human blood. A total of 7 to 8 c.c. (70 to 80 billion bacilli) is divided in three weekly (bilateral) injections of 1, 1.5, and 1.5 c.c. respectively. Sauer states that not one of the 162 injected children accidentally exposed has had a cough that in any way resembles pertussis. The experiences of this clinician lead him to believe that active immunity is completed in four months and lasts for years. Infants withstand the injections remarkably well, and the best age for immunization is the second half year of life.

THE FORUM

Dr. H. C. Pollock,
St. Louis, Mo.

Dear Doctor Pollock:

In the September issue of THE INTERNATIONAL JOURNAL OF ORTHODONTIA the discussion of the problem of the surgical removal of the frenum labium continues unabated.

I am, and have been for many years, tremendously interested in this problem. Perhaps my twenty years' experience in the practice of orthodontia will entitle me to an expression of my views, as follows:

First, it is more nearly normal than otherwise for the maxillary central incisors to erupt with a space between them.

Second, this space will normally close with the eruption of the other permanent teeth in the great majority of cases.

Third, if you are going to close the space by means of orthodontic treatment, the surgical removal is entirely unnecessary, as the frenum will disappear by means of the pressure atrophy brought about by the treatment.

Fourth, it has been my experience that much harm and no beneficial results follow this operation.

Fifth, the operation is rarely necessary. There may be cases where it is indicated, but I have never seen one.

In "The Forum" (September) Dr. Sydney W. Bradley, of Ottawa, Canada, says:

"Dr. Dewey answers Dr. Caine's query concisely and definitely. If the frenum is abnormal, remove it; if not, leave it alone."

The statement quoted above may sound trite, but it is entirely illogical. We should not forget that we quite often have abnormal heads and other parts of the human anatomy, but it does not follow that they should be removed. You might as well advocate the removal of the teeth because of malocclusion.

In my opinion, the procedure is a "hangover" from the gay nineties, and should be discarded from the practice of all thoughtful orthodontists.

Sincerely,

(Signed) J. E. TAYLOR,
Hollywood, Calif.

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EDITORIALS

About "The Crisis in Orthodontia"

UNDER the heading of "The Crisis in Orthodontia" THE INTERNATIONAL JOURNAL OF ORTHODONTIA AND DENTISTRY FOR CHILDREN in this issue starts the publication of a series of articles by Albin Oppenheim of Vienna, Austria, which are interesting and timely, as well as significant of the trend of orthodontic thought and progress. The articles start in the current issue and will appear serially until completed. The readers of the Journal will be interested not only in the scientific importance of these articles but also in the theme which runs through them, which is apparently intended to be constructively critical of modern mechanotherapy and some trends of thought.

It is to be recalled that the first experimental studies on the teeth of monkeys and the conclusions drawn from these activities, which were consummated about 1911 by Dr. Oppenheim, have for many years been somewhat of a yardstick for orthodontic practice. These former studies, which were published and have been extensively quoted, were largely the inspiration for turning orthodontic practice right about face from the use of strong pressure on teeth of the twist wire ligature, or the tie of a ropy grass line variety, to the application of gentle growth-provoking forces.

A part of the series has been published in *Zeitschrift für Stomatologie,* to which full credit is given. However, some slight changes have been made in the translation by the translators, Doctor Neustadt and his associates. The excellent cooperation of the translators in making this important work available to English readers is here acknowledged and is duly appreciated not only by the editors and publishers of THE INTERNATIONAL JOURNAL OF ORTHODONTIA AND DENTISTRY FOR CHILDREN but by English readers throughout the world.

Whether the reader agrees entirely or in part with Dr. Oppenheim is not so important as the fact that here is a really great survey, or cross-section, of the development of orthodontia up to the present.

The work consists of two parts, which cover the following subjects:

Part I:

1. Tissue changes during active mechanical tooth movement. Directions for the practice.
2. Tissue changes during the period of retention. Skogsborg's septotomy.
3. Critical review of the work by Gottlieb and Orban, A. M. Schwarz, and J. A. Marshall.

Part II:

1. The extraction therapy of Class II malocclusions (Angle).
2. The treatment of Class II malocclusions (Angle).
3. The problem of root resorption.
4. Contributions to the construction of appliances.
5. Permanency of results.

It is of further interest that Dr. Oppenheim will subsequently publish all these individual problems in the form of a monograph.

H. C. P.

Department of Orthodontic Abstracts and Reviews

IN 1915 the first issue of the INTERNATIONAL JOURNAL OF ORTHODONTIA appeared. The Journal was launched during the early period of orthodontic development because it was believed that there was a great future for orthodontia and for the service it would render the public. Even at that time spectacular and highly creditable results were being secured in the correction of malocclusions by many who had been reasonably well trained for the work. Accordingly, it was felt that this subject was destined to take a very important position in scientific endeavors and that there was a place for a journal devoted to recording orthodontic literature and thought.

In the years since its first appearance no effort or expense has been spared to make the INTERNATIONAL JOURNAL OF ORTHODONTIA a publication of which the specialty of orthodontia and the profession of dentistry could well be proud.

The Journal has contributed nineteen volumes to orthodontic literature, covering the last two decades in a specialty which even now is hardly more than thirty years old. During this time the Journal has undergone several constructive changes in name, and thereby adapted itself to other branches of dentistry which it has served. These changes were made from time to time to meet the gradually increasing demands of the orthodontic profession and its allied branches.

There are other changes taking place—interesting developments in Europe and other countries regarding orthodontia and its kindred biologic sciences which broaden the international scope of this publication. Important scientific orthodontic literature, both textbooks and papers, is appearing in many foreign countries.

Orthodontists throughout the world are eager to follow carefully the current trends of thought. Accordingly, this Journal takes pleasure in announcing a Department of Orthodontic Abstracts and Reviews. This new department will be under the direction of Dr. Egon Neustadt of New York City, in collaboration with Dr. Jos. D. Eby also of New York City, with such assistance from the editorial staff as they may require. The new department will appear in January, 1934, celebrating the first number of the twentieth volume of the Journal.

Through the very kindly cooperation of Dr. Neustadt and Dr. Eby the readers of the INTERNATIONAL JOURNAL OF ORTHODONTIA AND DENTISTRY FOR CHILDREN may now each month have the advantage of reading translations and reviews of the latest important foreign literature.

NEWS AND NOTES

Thomas P. Hinman Midwinter Clinic

The annual meeting of the Thomas P. Hinman Midwinter Clinic will be held Monday and Tuesday, March 12 and 13, 1934, at the Biltmore Hotel, Atlanta, Ga.

Jos. D. Osborne, Secretary,
604 Doctors' Building,
Atlanta, Ga.

Fisher's Orthodontic Directory

Fisher's Orthodontic Directory will be published in January, 1934. All changes of addresses should be sent to the editor, and new members who are eligible to have their names listed should communicate immediately with

Claude R. Wood, Editor,
Medical Arts Building,
Knoxville, Tenn.

Department of Orthodontic Abstracts and Reviews

For several years, there has been a growing interchange of scientific data between orthodontia, general dentistry and medicine; this holds particularly true for research work which has been continually in progress in this as well as in other countries. As a result, there are numerous current periodicals and textbooks published which abound in a rich fund of knowledge and which should be incorporated into the substance of general orthodontic progress.

The modern orthodontist is anxious to familiarize himself with these problems, but the number of textbooks and current articles in fields not strictly orthodontic, though related to orthodontia, make it practically impossible for him. Even the most adept reader cannot devote sufficient time and persuasion to cover such voluminous matter. Although generally interested in the subject, he does not care to read through the dull portions of lengthy articles in order to reach the conclusions.

Furthermore, orthodontists in America and in other parts of the world would like to have a more complete knowledge of progress and research as it is going on abroad. However, this endeavor meets with several difficulties, first, the procurement of foreign magazines and textbooks as well as the time and expense necessary for the translation of unnecessary volumes of material. At present there is no source by which the American reader can find literature of a current nature in order to keep in touch with foreign affairs.

It is the intention in the new department to make all pertinent literature easily available to orthodontists by presenting it in a condensed form. The most important American textbooks and current articles will be abstracted so that the reader may cover within a few minutes what would otherwise require an equal number of hours. Special attention will be paid to scientific articles and original research work. All foreign orthodontic textbooks and current magazines will also be reviewed, and such material as will be found to be of significant importance will be included in this department. The sources of these articles not only

will be indicated but information service regarding them will be made available to any one who expresses his desire to look further into the particular subject.

There is much matter in a detailed description which is not familiar knowledge and which is not essential even if clearly understood. The fundamental principles of an article together with the conclusions are the things the average reader is generally trying to arrive at. In this department he can read many interesting abstracts and take them with him for future thought and knowledge, all this in the same length of time as would be required to read through one unabridged publication.

Notes of Interest

Dr. Willard H. Parry announces the removal of his dental office to 1001 Huntington Building, Miami, Fla.

Dr. Jay N. Pike announces the association of his son, Dr. Joe M. Pike, in the practice of orthodontia, for children and adults. Office at 811 Medical Arts Bldg., Minneapolis, Minn.

ERRATUM.—In the November issue in connection with the announcement of Dr. Carl P. Cline's opening an office in Washington, D. C., it was stated in error that he was still maintaining an office in New York City; Dr. Cline's office is in Norfolk, Va., not New York City.

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D

EDITORIALS

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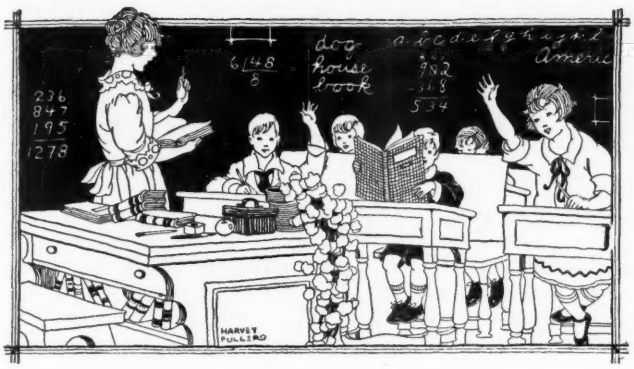

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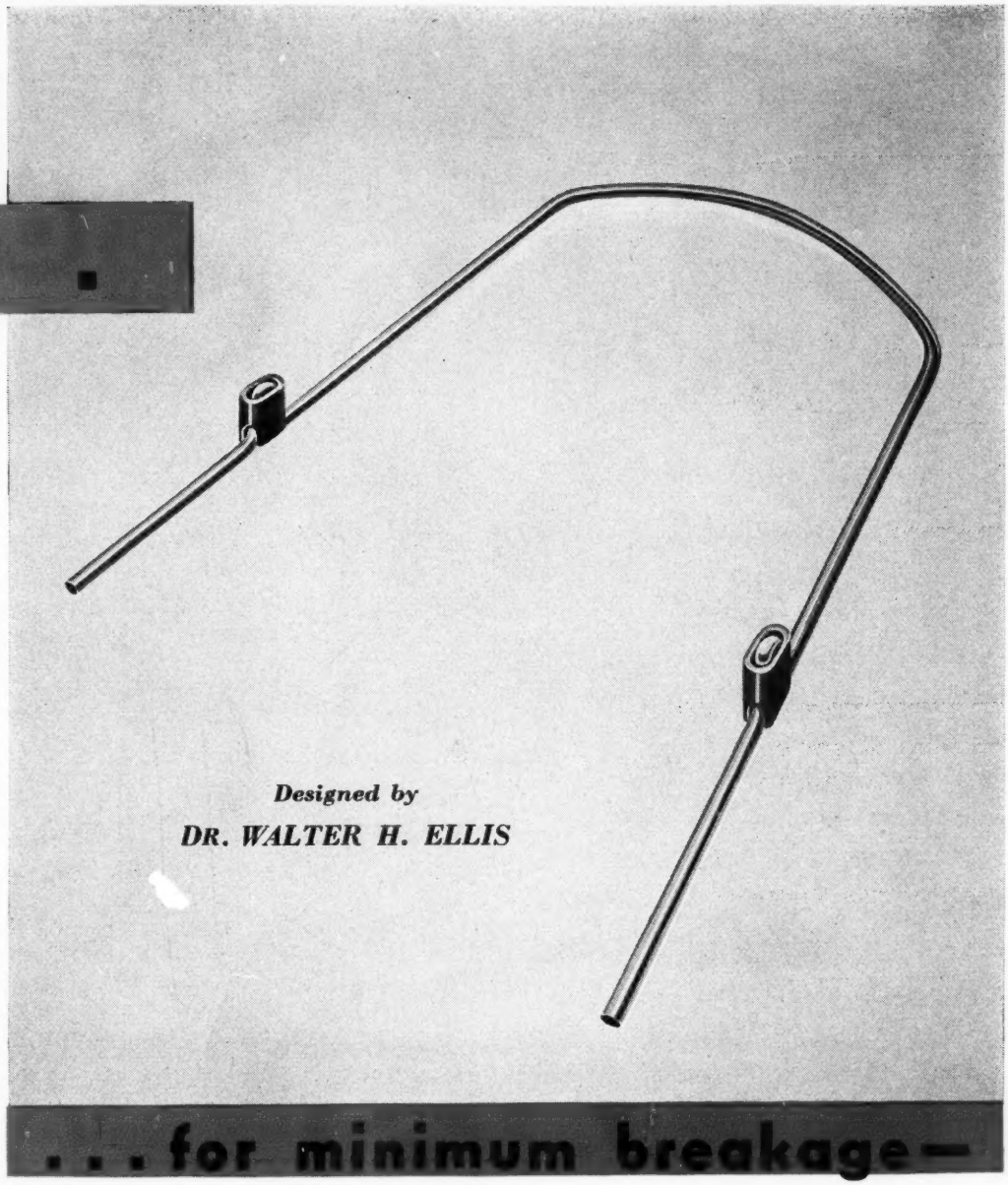

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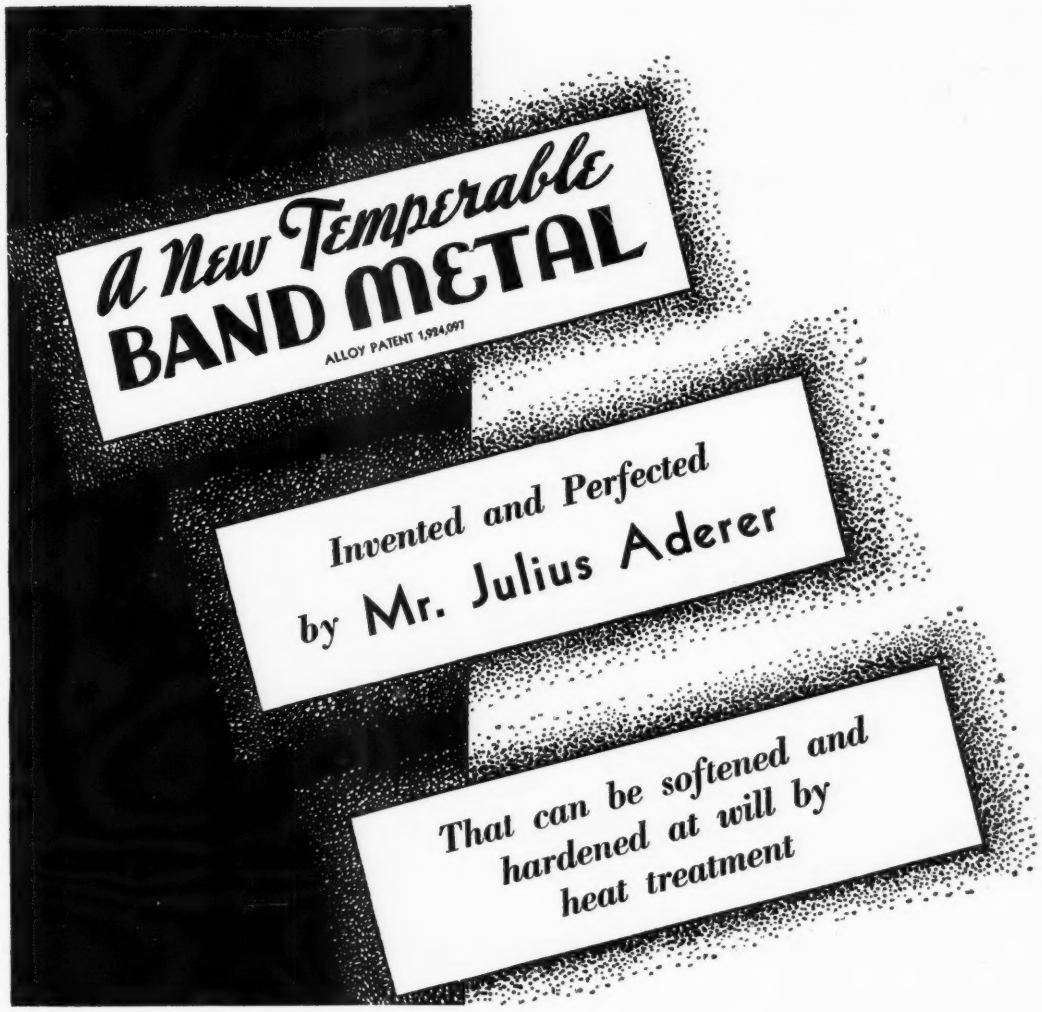

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(See page 1196 for further information.)

WIRES AND BANDING MATERIAL

ORTHODONTIC WIRES

ALLOY J

No finer alloy is obtainable than Alloy J for small gauge resilient arches, delicate finger springs, sliding devices and for all techniques calling for wire which must be both elastic and tenacious. There is practically no danger of breakage with this wire. It is very high fusing and is platinum colored.

Q-A

A high fusing clasp alloy with great strength and elasticity. It is rich in platinum metals, is platinum colored and especially recommended for arches. It has exceptional tempering quality.

HIGH FUSING

An excellent, all-purpose, platinum colored alloy containing 12 per cent platinum group metals. It is very tough and resilient.

ORTHOSPRING

Somewhat lower in fusing point than the alloys just described, it is yet highly elastic. A fine and comparatively inexpensive wire for general use. Platinum color.

SIX PER CENT

A dependable, elastic, gold-platinum wire for arches and springs. It is strong and tough.

All these alloys respond readily to scientific heat treatment. Properly tempered, they at once regain any springiness which may have been lost during the process of soldering.

BANDING MATERIAL

PLATINALOY

This is an extremely high fusing alloy of gold and platinum metals only and has been formulated especially for orthodontic use. Its great edge strength insures against crimping and tearing. It is very easily contoured and adapted. It is completely unoxidizable in the flame and is immune to discoloration in the mouth. Pure platinum color.

PLATINUM 10% IRIDIUM

It is possible again to use this old standby. We have been headquarters for this alloy ever since the birth of orthodontia.

G-K

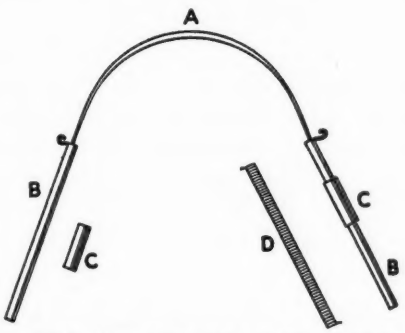
This is an alloy in which gold, platinum, palladium and rhodium predominate. The rhodium adds greatly to its strength and elasticity, without appreciably lightening the gold color. It is very tough and durable and banding material made of it is perfectly dependable. It is high fusing.

18 KARAT GOLD CASED

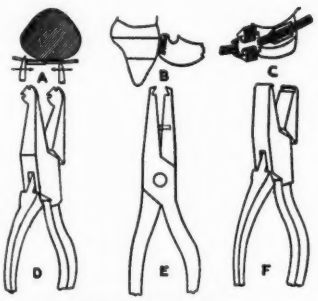
Baker Gold Cased Band Material owes the lasting quality of its protective covering to the replacing of electroplating by what is commonly known as "rolled gold." The casing is a continuous, unbroken shell over the base metal body. This casing adheres closely at every point of contact to the invested metal—as perfectly upon the edges as upon every other part. No amount of bending will loosen it. We recommend solder 450 fine for use with it.

All our band materials will be supplied in any width, any thickness. They may be had in foot lengths or in rolls of any length desired.

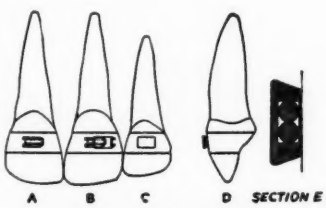
THE JOHNSON TWIN WIRE AUTOMATIC APPLIANCE . . . .



A Twin Wire Arch with wires separated to show construction.
B End Tubes with hooks.
C Buccal Tubes.
D Spring.



D Band Seator in action.
E Band Placer.
F Band Placer as used to tighten female part.



A Fitted Band, showing male part.
B Same band with female part slipping into position.
C Band with complete lock. D Side view of band and male part.
E Lock in section showing position of wires.

DURING several years of experimentation, Joseph E. Johnson, D.D.S., F.A.C.D., was much impressed by the small amount of tooth movement which would correct the average case of malocclusion. His observations led to the designing of a new method employing a twin wire alignment arch, composed of two small wires which are passed through tubes as shown in Fig. 1.

The tubing is made from an especially hard alloy. A tube of .043" is equal in strength to .040" iridio-platinum arch wire. The theory behind this new arch, after the premise already stated, is based upon the fact that a small wire is more resilient than a large one. By using two small wires, the force of the large gauge and the elasticity of the smaller are secured in a single unit. The device is not intended for widening the dental arch in the bicuspid and molar region. A summary of its advantages follows:

It is very easy to construct and operate. Requires only bending of the twin wires to alignment with the normal arch and locking to the teeth.

Teeth are automatically moved out to this arch form. There is automatic movement of root as well as crown. The movement is rapid, without discomfort and the tissues are not injured.

It is easy to clean. It is sturdy, despite apparent fragility, and is seldom broken by children.

It continues work over a long period. Frequently when removed, after three or four months, it is found still exerting pressure.

It is very neat looking.

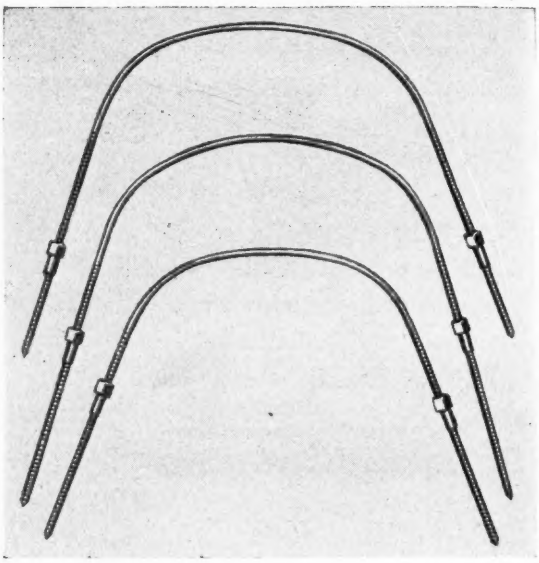
While pressure is constant, it is very light and produces physiological tooth movement.

The operator has perfect control over the amount of force developed.

BAKER ARCHES

HIGH TENSION EXPANSION ARCHES

If your technique calls for the use of the Expansion Arch you will appreciate the careful workmanship and finish of the BAKER Arch. Made in three sizes—large, medium, and small—of 19-gauge round wire. Accurately threaded ends and nuts. Supplied in precious metal only. Platinum color. Sizes as illustrated.



RIBBON ARCHES (ANGLE SYSTEM)

BAKER Ribbon Arches are light, strong, and resilient. Complete with threaded ends and accurately made nuts, in three sizes as illustrated above. Gauge .022″ x .036″. Platinum color.

REGULAR RIBBON ARCH WIRE

Supplied in foot lengths HIGH FUSING Alloy. Size .022″ x .036″.

TINY RIBBON ARCH WIRE

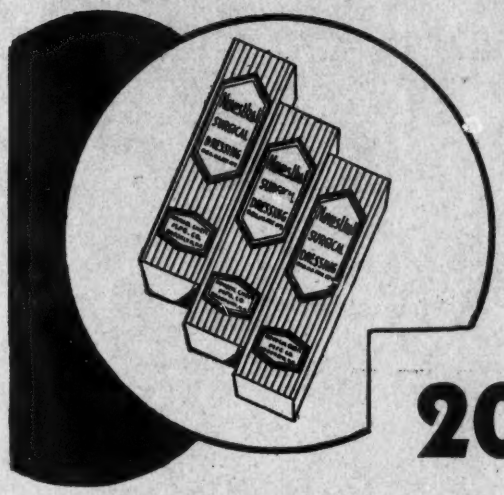
Same as Regular Ribbon Arch Wire, but in sizes .022″ x .028″.

RECTANGULAR ANCHOR TUBES

These tubes are soldered to the molar bands and are made to fit regular ribbon arch wire. Bore .022″ x .036″.

TINY RECTANGULAR ANCHOR TUBES

To fit tiny ribbon arch wire. The bore is .022″ x .028″.



20 Uses

for Novesthol Liquid and Novesthol Surgical Dressing!

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Novesthol Liquid **and** ***Novesthol Surgical Dressing*** **contain Procaine and Novesthene—the Procaine rapidly anesthetizes the sensory nerve fibres; the Novesthene, by virtue of its slow solubility, prolongs the anesthetic action. Novesthol is readily absorbed and is non-irritating.**

That's why Novesthol is "*indicated*" in a wide variety of conditions—pulpitis, hypersensitive dentine, gingivitis, denture abrasions, dry sockets, elimination of pain from insertion of needle, relief of gagging, etc.

If you aren't a Novesthol user, just attach your card to this advertisement and mail it to us for a *trial tube of Novesthol Surgical Dressing*, together with an article listing 20 outstanding uses of Novesthol in everyday practice.

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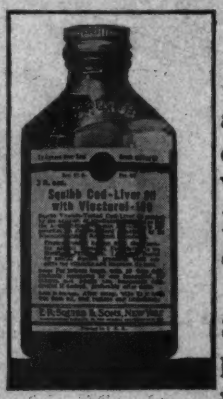
Prescribing a "10 D" Oil for the first time?

Be sure it is SQUIBB'S!



Try this *richer* cod-liver oil fortified with Viosterol for growing children who need special help in tooth calcification.

And be sure they receive *all* the important vitamin values you prescribe. Insist on *Squibb's* cod-liver oil with Viosterol-10 D.

A special process protects the high potency of Squibb's "10 D" Oil. It is prepared under conditions which exclude oxygen to protect it against deterioration. Therefore, every dose supplies full vitamin value. It is less expensive than oils which have to be given in larger dosage because the vitamin content is less.

And Squibb's "10 D" is such an effective routine measure for the growing child! It contains *ten times* as much of the essential bone-and-tooth building factor—Vitamin D—as the standard cod-liver oil defined by the Wisconsin Alumni Research Foundation.

As prepared by Squibb, it also provides children with an abundance of Vitamin A.

Vitamin A helps them to grow and to keep their resistance high.

Every gram of Squibb's "10 D" Oil offers not less than 1,333 A.D.M.A. (133 Steenbock) units of Vitamin D and not less than 1250 U.S.P. units of Vitamin A.

Now—*every day* for growing children — Squibb's Cod-Liver Oil with Viosterol-10 D. Plain or with an agreeable Mint-Flavor. Squibb's is the *only* "10 D" Oil that comes flavored with mint.

SQUIBB'S COD-LIVER OIL with VIOSTEROL

PLAIN
OR MINT-FLAVORED

10 D

Manufactured under license from the Wisconsin Alumni Research Foundation and acceptable to the Council on Dental Therapeutics of the American Dental Association

INDEX NUMBER

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Of course, Bond Bread alone won't make strong, sound teeth. But the latest research makes it obvious that an extra source of vitamin-D is most desirable in the war against dental caries. And Bond Bread richly provides it.

Many dentists find their patients anxious to learn easy methods to protect their teeth. In addition to foods containing other necessary elements, they find Bond Bread the easiest and pleasantest way to get that extra vitamin-D which nutritionists agree is so desirable for adults and children alike.

We would be glad to provide you, free of charge, with a booklet, "Food for Sound Teeth." It gives authoritative information on decay-preventing diets. For further information write to Dr. J. G. Coffin, Technical Director, General Baking Company, 420 Lexington Avenue, New York City.

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Your Protection in Recommending Bond Bread

The claim that Bond Bread is a rich* source of vitamin-D is accepted by the Committee on Foods of the American Medical Association. Vitamin-D is added to Bond Bread under the most rigid scientific supervision. The vitamin-D potency is, therefore, uniform and reliable. Best of all, the extra vitamin-D is absolutely free to the public.

**Bond Bread contains 95 Steenbock Vitamin-D units per pound.*

Experiments now in Progress Prove need for more Vitamin-D**

In four institutions for children, caries were reduced greatly simply by adding vitamin-D to the normal diet. The children were already receiving what is generally considered an adequate diet, even including the ordinary supply of vitamin-D and sunshine—yet those who got no extra vitamin-D had *two times* as many cavities! The dentists making the examinations were completely impartial. They did not even know which children had received the extra vitamin-D.

The prevalence of rickets among children is evidence of the need for vitamin-D. Caries in adults is a sign of the continuing need of additional vitamin-D in later life.

***Name of research organization on request.*

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***Rich sources of* vitamin-D**